NOVEMBER/DECEMBER 1974

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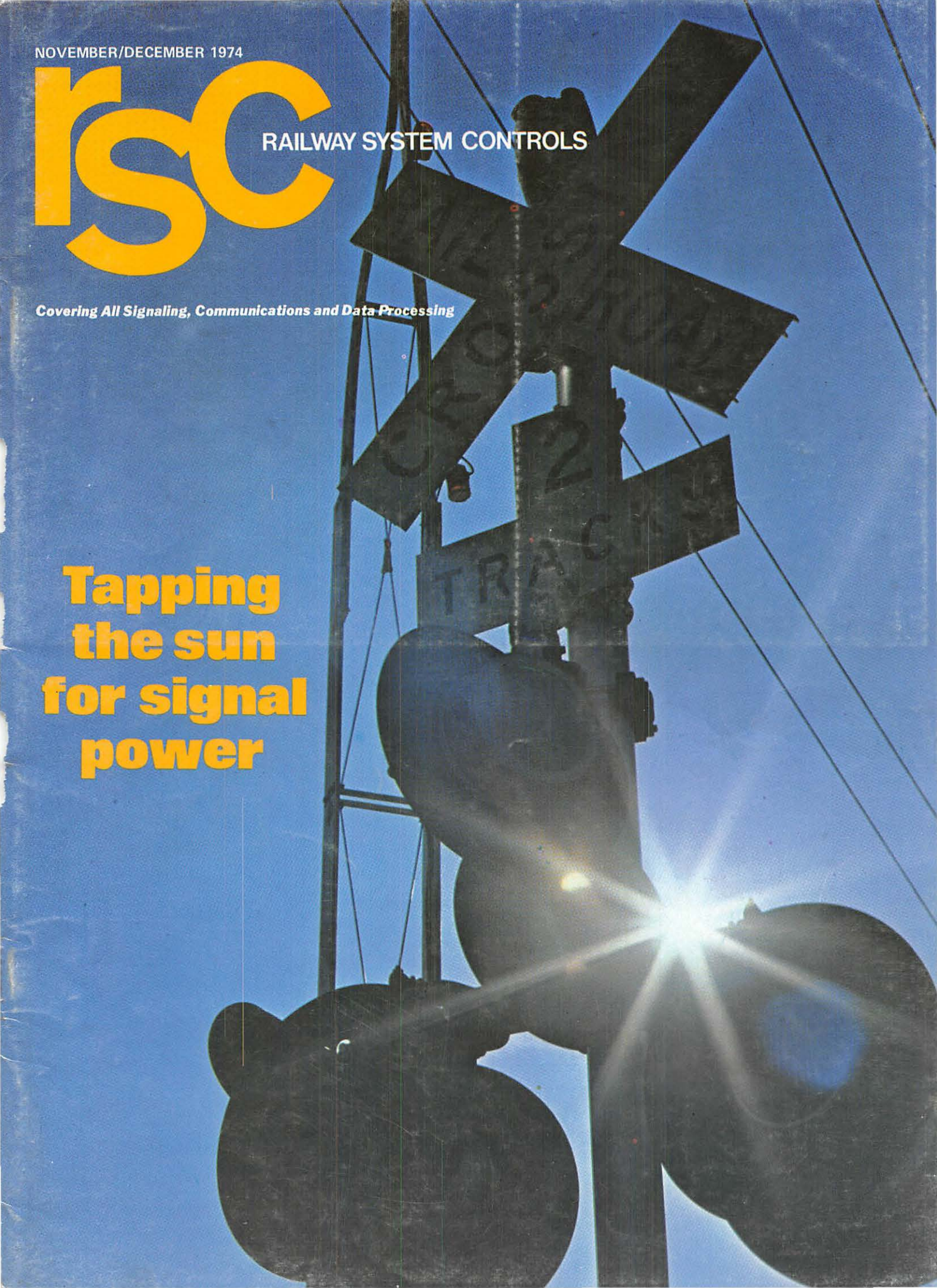

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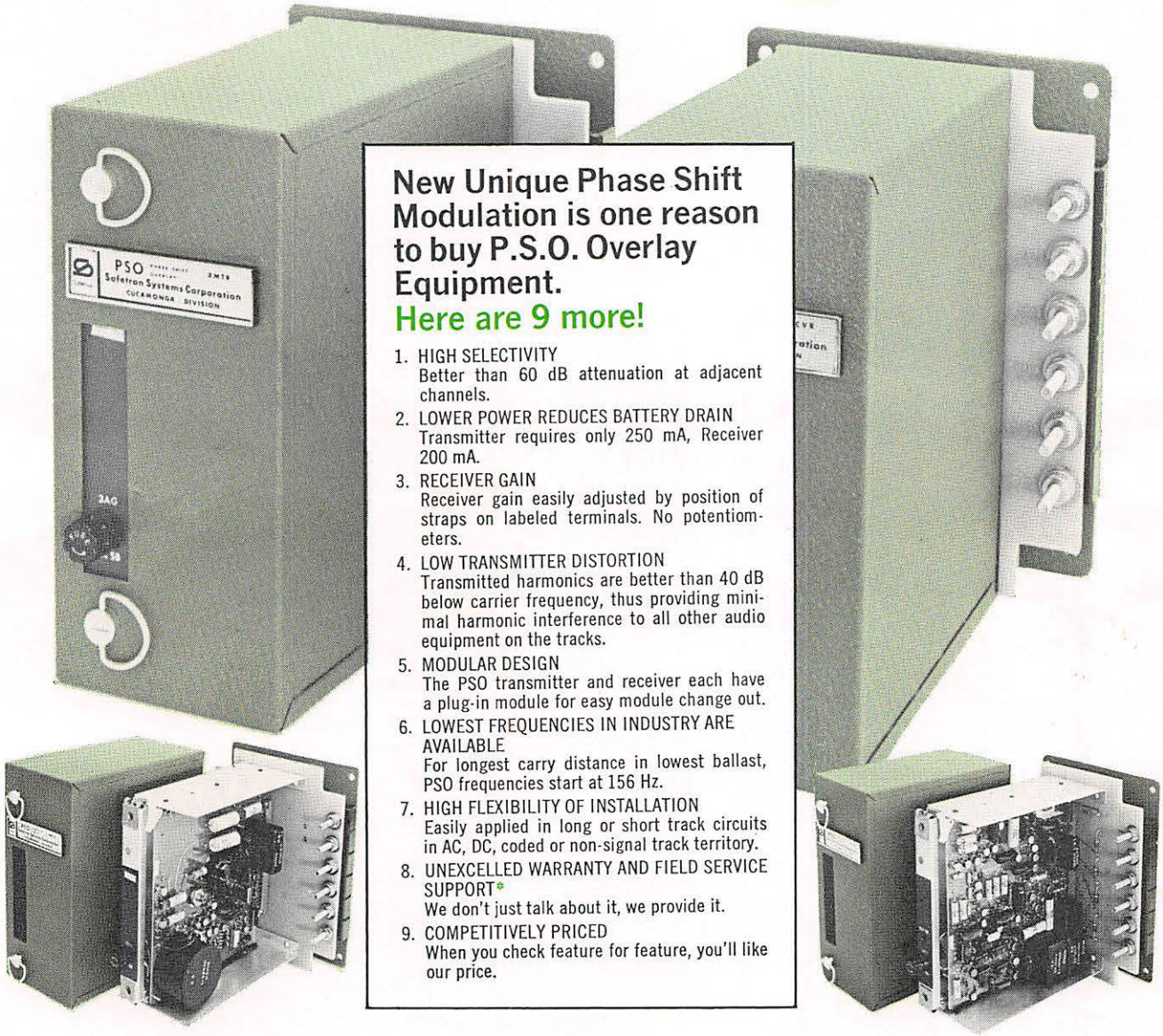

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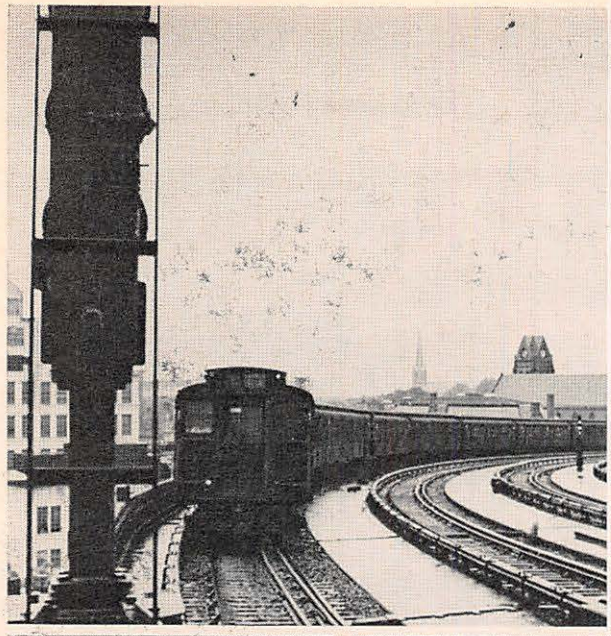

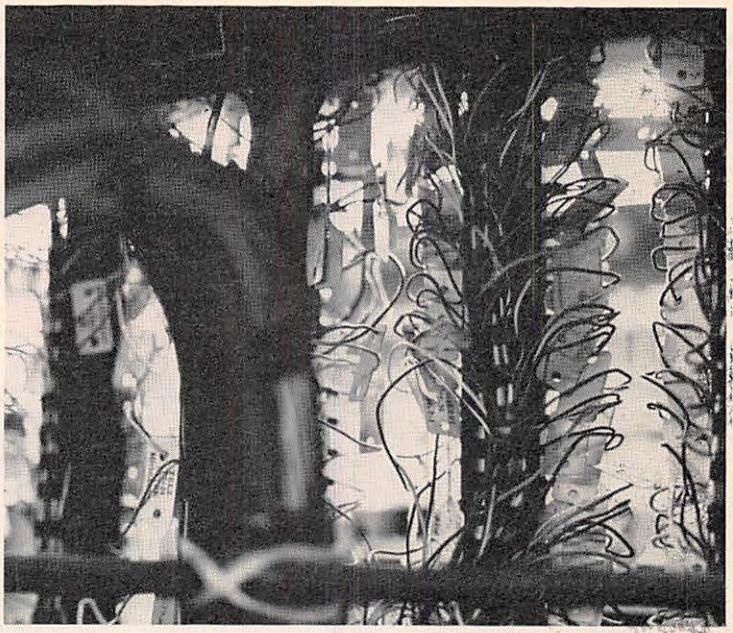

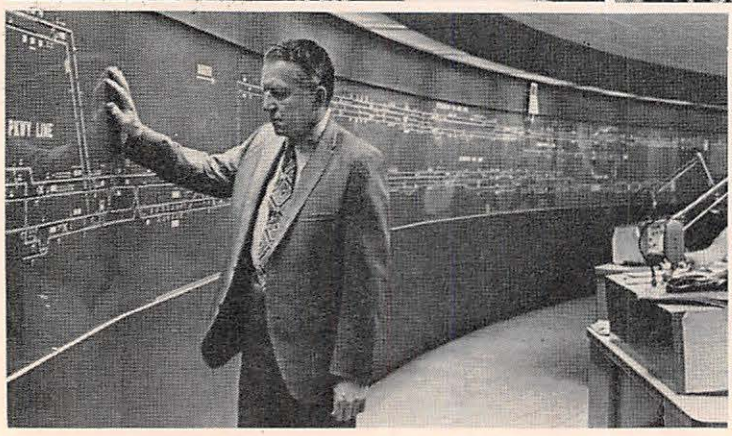

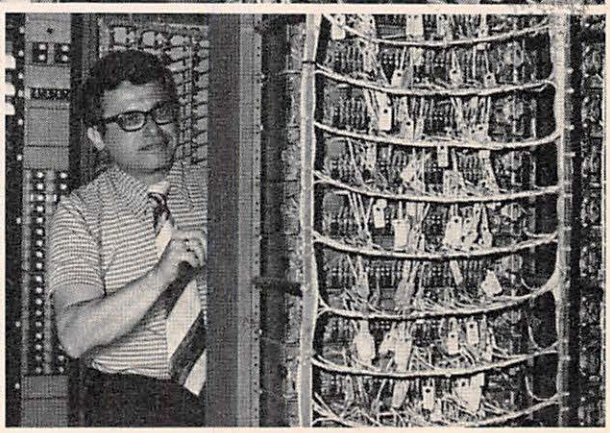

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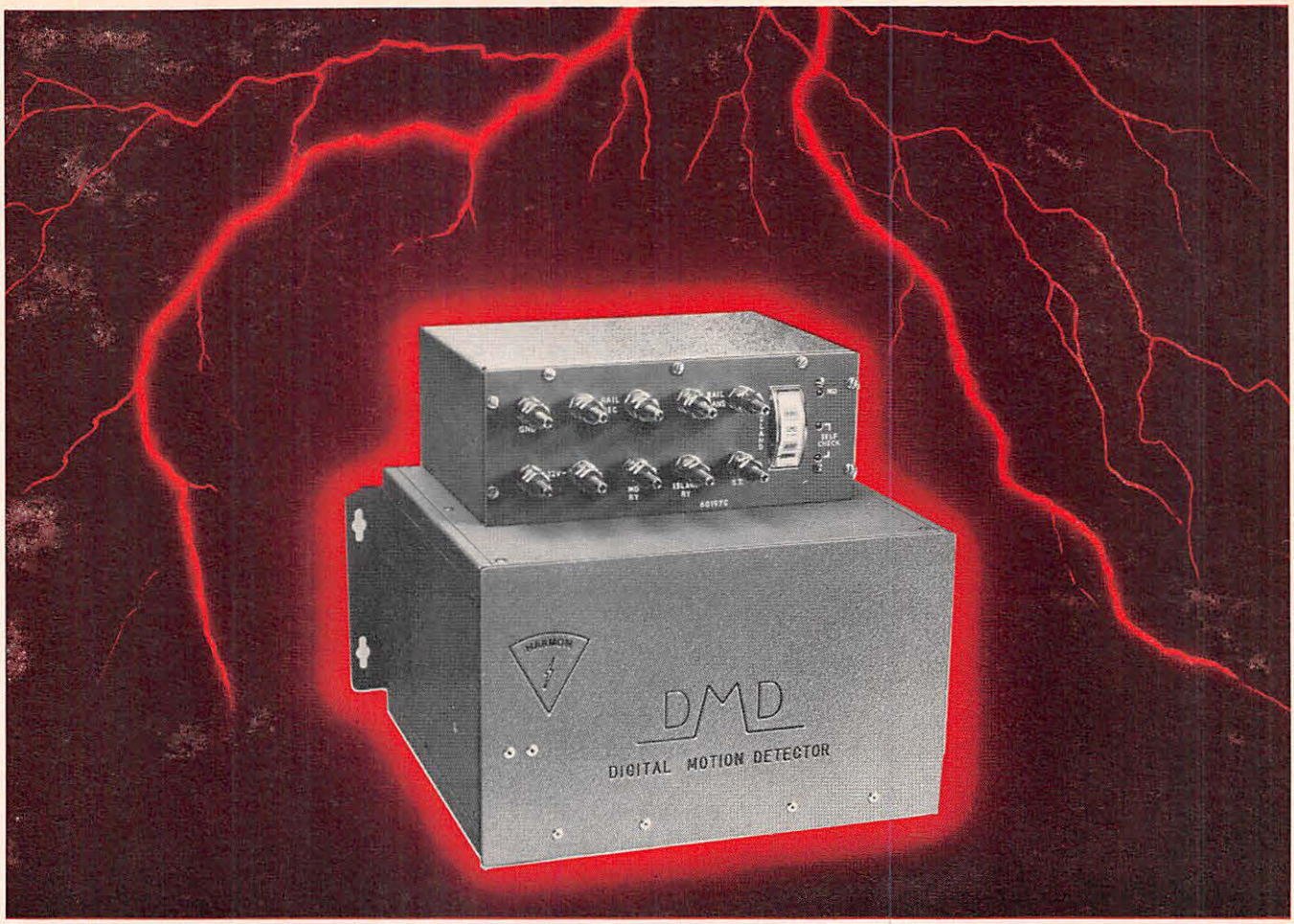

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NOVEMBER/DECEMBER 1974 Vol. 5 No. 10

RSC RAILWAY SYSTEM CONTROLS

(Formerly Railway Signaling & Communications)

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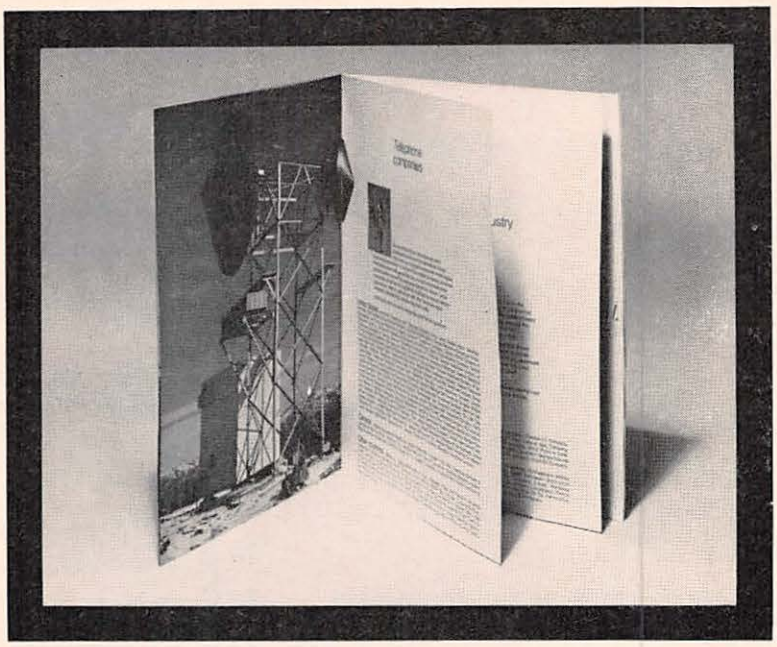

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Industry news

. . . a quick look at current events throughout the railroad industry

Freight traffic on U.S. railroads during the week ended Nov. 23 totaled an estimated 15.3 billion ton-miles, 3.3 percent below the corresponding week a year ago, according to the Association of American Railroads. Cumulative volume for the first 47 weeks of 1974 was an estimated 786 billion ton-miles, 1.9 percent above the comparable period last year.

A merger of Missouri Pacific, Texas & Pacific and Chicago & Eastern Illinois into MP was recently approved by shareholders of the three roads. Next move: Filing an application with the ICC. MoPac will be the surviving company and, when all approvals are received, the merger "will be consummated as a statutory merger resulting in the complete unification with MoPac . . . acquiring all assets and assuming all liabilities of T&P and C&EI."

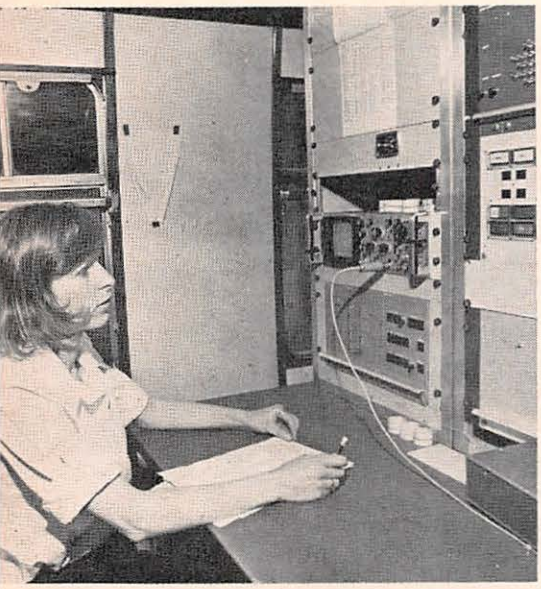
The first units of the RAILBOX fleet have been delivered by ACF Industries' Amcar Division plant in St. Louis, Mo. The 50-foot, all-steel box cars will be a part of a nationwide pool which is to be operated by the American Rail Box Car Company, a subsidiary of Trailer Train Co. The RAILBOX fleet will be made available to participating railroads on a "free-running" basis, not subject to mandatory car service rules which regulate the movements of railroad owned box cars.

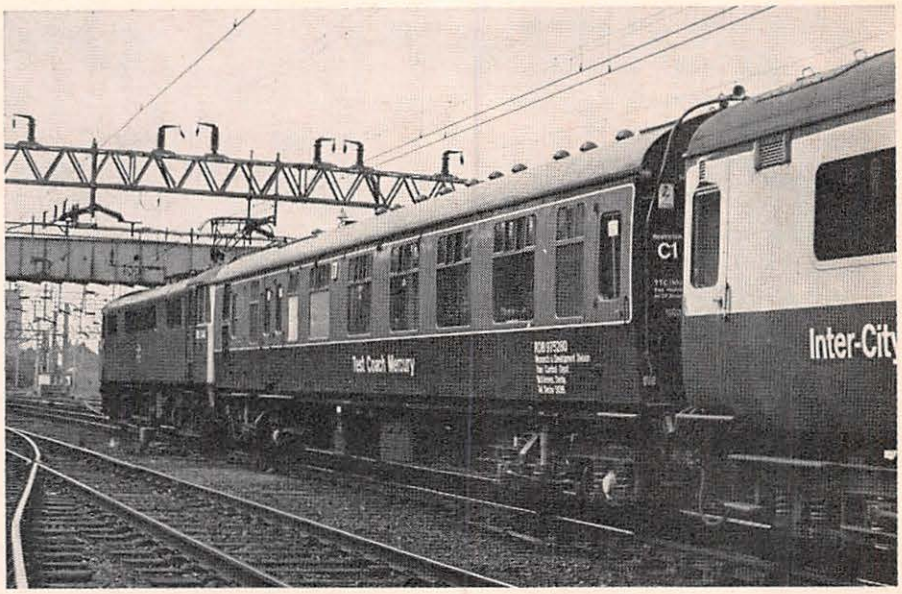
Reporting railroads claimed $2.6 billion in deferred maintenance on roadway, $337 million on equipment and a total of $4.3 billion in delayed capital improvements as of June 30, according to a recent report from the ICC. The delayed capital improvements reported by the railroads were almost evenly divided between roadway and equipment. The Commission's Bureau of Accounts compiled the data from reports filed by individual railroads as required in a recent 10% rate increase approved by the ICC.

Three railroads and the Auto-Train Corp. have reached an agreement for setting up a truck-train service between Florida and the Northeast and between Florida and Louisville, Ky. The concept of the new service is similar to that now offered by Auto-Train, which ferries automobiles and their drivers between Lorton, Va. and Sanford, Fla., and between Louisville and Sanford. Reaching agreement in principle with Auto-Train on the new service were the Seaboard Coast Line, the Louisville and Nashville and the Richmond, Fredericksburg and Potomac. According to Eugene Garfield, Auto-Train president, "The fare will be such that it will prove economically beneficial for truckers to utilize this service."

In response to a National Transportation Safety Board recommendation, the Federal Railroad Administration has issued an "emergency order" restricting the handling of tank cars loaded with flammable compressed gases. Under the FRA order, uninsulated tank cars carrying such materials are not to be cut off from a train while in motion, and no car moving under its own power is to be allowed to strike such tank cars if the tank cars are not equipped with head shields recently recommended by FRA. In addition, other cars are not to be coupled with the tank cars with any more force "than is necessary to complete the coupling."

RSC News





British Railways test car evaluates track-to-cab signal system

Track mounted "transponders"—which respond to signals from trains passing above them—are being tested by British Railways to evaluate their usefulness in transmitting important information direct to the engineer's cab.

These devices could have widespread application in systems for bringing train-operation information into the locomotive cab. Transponders can be used, for example, to transmit information about speed restrictions or a unique location code which would enable automatic equipment on the train to verify the train's position en route.

BR is using a new mobile laboratory, Test Coach Mercury, to evaluate an initial batch of 30 transponders laid between Euston (London) and Birmingham. Manufactured by the Plessey Co., the units are coded during manufacture and the code can not normally be subsequently changed. By the end of 1974 there will be about 150 transponders on the line.

The test coach is coupled to any convenient train and is used only as a laboratory—it plays no part in the running of the train. It is operated from London to Birmingham and back about three times a day.

A major advantage of transponders, say BR engineers, is that they are passive—requiring no internal energy source such as batteries, or main supply. Power required to operate the electronic circuitry is derived from the inductive energy transmitted to the transponder by the train. In return the transponder then transmits a coded inductive signal back to the train.

As the laboratory coach passes over the transponders, signals at a frequency of 150 kHz are transmitted from an underfloor antenna. Some of the received energy is used by the transponder to generate power for the solid state circuitry which generates a coded 75 kHz signal which is then transmitted back to the train. The code is in the form of binary coded decimal numbers, and 80 bits are available for coding, providing a very high number of combinations.

The return signal is picked up by a receive antenna next to the transmitting antenna below the train floor. It is fed into processing equipment and passed to a minicomputer for evaluation.

The transponder evaluation program will continue until the reliability of the technique is established. After thorough evaluation, transponders might be used in a number of ways in future train control systems. One system would employ transponders coded with speed information, relevant to a particular stretch of track, which would be read by the train as it approached that section. Another possibility would use stored speed supervision information on the train which would be read as the train progressed en route. To insure that data were keeping step with the actual running of the train, transponders would act as position markers. Speed information would be displayed in the cab only if full correlation were established.

CN to build new computer facilities in Winnipeg

A decision by Canadian National to undertake a major expansion of its computer facilities will see the creation of a multi-million dollar computer center in Winnipeg, Man., by 1976.

The decision was announced recently by A. R. Williams, vice-president of CN's Prairie Region, following a CN board of directors meeting in Winnipeg. The expansion will allow the railway to keep pace with, and plan for, its information processing needs associated with increasing traffic. Volume of freight moving over CN has increased by more than a third in the last four years and is expected to continue growing.

Expansion of CN's computer facilities will involve installation of two IBM 370/158 computers, one in Montreal in 1975 and the other in Winnipeg early in 1976. The expansion is expected to mean 30 new jobs in Winnipeg, 20 in Montreal and an annual payroll of three-quarters of a million dollars.

The Winnipeg center will carry out a

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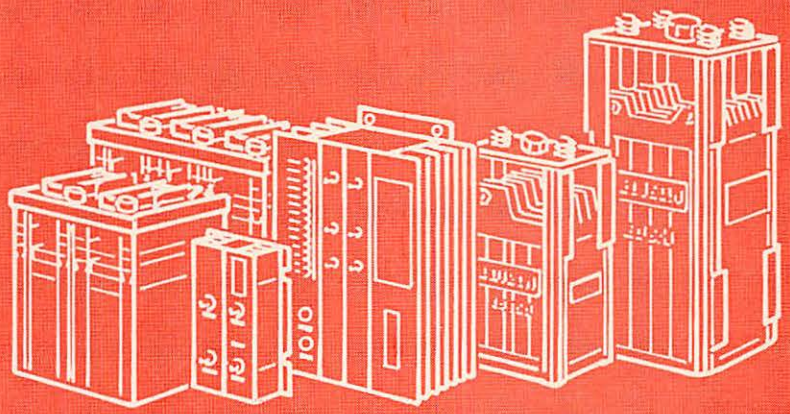

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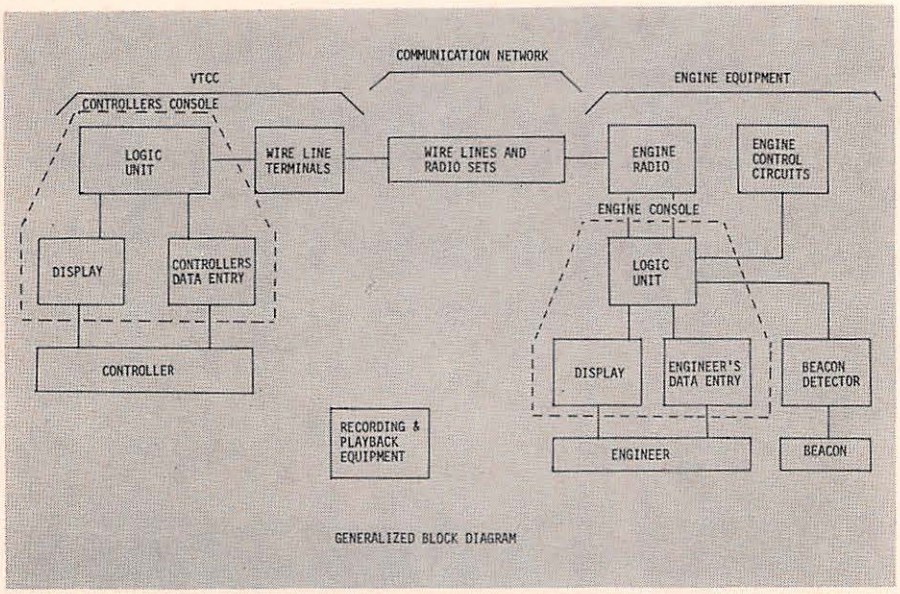
(continued from page 8)

wide range of general accounting functions, process payrolls and assist with inventory control for the entire railway. It may also be used to simulate future freight train operations in Western Canada where traffic growth will be great.

The increased capacity of CN's computer services, while improving availability and reliability, will be in addition to existing regional computer facilities in Edmonton, Alta.; Winnipeg; Toronto, Ont.; and Moncton, N.B.



GENERALIZED BLOCK DIAGRAM

FRA OK's testing of voice train control

The Federal Railroad Administration has given the go-ahead to the Baltimore & Ohio for development and testing of a new concept in rail traffic dispatch and control. The concept, known as Voice Train Control System (VTCS), utilizes continuous radio communication, as well as remote-control train stop capability. The B&O had petitioned for approval to test the system over 552 miles of track in central Ohio.

John W. Ingram, then Federal Railroad Administrator, said: "The concept is similar to aviation's highly successful air traffic control system but with the added feature of providing for the automatic halting of a train if communications between engineer and dispatcher break down."

In addition to voice communication between train and dispatcher, each locomotive cab will be equipped with a display console showing train movement instructions.

In its petition to the FRA, the B&O emphasized that VTCS is basically a manual system operated by humans with an automatic monitoring and back-up capability. It is not an automatic system with human backup. "The automatic equipment steps in only when the people involved have appeared to be unwilling or unable to recognize a safety-related situation," Ingram said.

Automatic sequence can be initiated by VTCS if one of the following conditions is present:

—Locomotive proceeding into a control zone for which it has no authorization.

—To occupy (equivalent to running a stop signal on a conventional system).

—Overspeed by locomotives.

—Trains in emergency braking, which will cause the system to warn other trains on parallel tracks in the vicinity to stop immediately.

The B&O petition also pointed out that a number of reminders and stop orders are displayed by use of visual displays and sound alarms utilizing the engine console. For each of these reminders or stop orders, the engineer is required to acknowledge by taking certain actions. If the engine crew fails to take action within 15 seconds, a corresponding indication will appear on the dispatcher's board, giving him the opportunity to take corrective action by remote control. In the unlikely event that both the engineer and the dispatcher fail to acknowledge the warning or stop order, a forced stop sequence is automatically initiated. This causes the diesel engines to return to idle and a service application of brakes to be made. A forced stop can be released only by proper action at the dispatcher's office. A forced stop would be the only case where a train is under the physical control of the automatic equipment rather than the engineer. Physical control of the train is in the engineer at all other times.

Although the B&O isn't saying which manufacturers are working with them on the VTCS, it is known that the Transportation and Environmental Operations division of TRW Inc., McLean, Va., has been working on a similar system for some time now.

The FRA approval calls for installation of the system within one year, and provides for a three-year period once the system becomes fully operational. The notice of approval also requires B&O to file a full and final set of specifications with the FRA no later than Dec. 31, 1974.

FCC OK's microwave for TRAIN II

The Association of American Railroads has received a waiver from the Federal Communications Commission to use microwave communications systems owned by individual member railroads. The AAR requested the waiver to allow it to use its member railroads' facilities to move data for TRAIN II, a nationwide freight car information system. The data provided would include a perpetual inventory and short-term projections concerning use and disposition of some 2 million cars.

Computer and communication seminars slated for 1975

The Institute for Advanced Technology is offering a wide selection of technical seminars which are scheduled well into the first half of 1975. Topics include: Data communications systems, design of a data communications system, practical engineering of data communications, computerized networks design, data base concepts, data base structures and file organization, applied programming technology, advanced programming techniques; structured design, and structured programming. For more information contact: Registrar, The Institute for Advanced Technology, 6003 Executive Blvd., Rockville, Md. 20852.

RSC RAILWAY SYSTEM CONTROLS

Railroading 1980—future trends in communications and signaling

During the last decade, the railroad industry has undergone more changes in signaling and communications technology than probably occured in the previous 75 years. What changes will the next decade bring? Will the classification yard be as we know it today? How about highway crossing systems, radio communication, and mass transit? A great deal of insight to what the future may hold for the railroad industry is presented in the following paper which was presented by D. D. Huffman, vice President Engineering, US&S, at the recent annual meeting, Communication & Signal Section, AAR in Atlanta, Ga.

The advent of solid state electronics has revolutionized equipment, process control, and management information possibilities. It has produced diverse equipment which spans the range from integrated circuit components the size of an aspirin to high density computers and related equipment which fill a room or building. These devices have made feasible an automation of processes that we scarcely dreamed of 13 years ago.

Given this rapid change in technology and present uses of new equipment, we can't help but wonder what is in store for us in the future. My purpose here today, is not to predict the future, but to put some thought in your minds concerning factors that will have influence and things that appear to be trends in our business; challenges that will likely present themselves, and associated problems that will need to be solved. The discussion will basically consist of two parts. First, we will cover some of the factors which will have influence on railroading in the future, and then, we will scan briefly what the future has in store for the major control system areas of the railroads.

Let me start with some items which I believe will be of major concern to us in the future.

There will be increased emphasis on safety and safety management. This aspect of our business has always been

D. D. Huffman, Vice President Engineering, Union Switch & Signal Division of WABCO.

treated with the very greatest concern by the Signal System fraternity and governmental agencies. The record of safety achievements in the past has been outstanding. Our aim in the future must be to continue to follow strict design practices and maintain the high standards of safety and reliability that we know is required. We must exercise extreme caution when departing from known standards and solutions. And, finally, we must formalize the safety practices and procedures so they can be handed down to the generations to follow or to educate those who are unfamiliar.

The already heavy demand for rail freight will increase in the 1980's. The general upward trend of the gross national product index suggests increased output of factories and the resultant movement of raw materials and finished goods from one company to another, and to the consumer, both here and overseas.

Such increases in the volume of rail transportation will require railroad management to look to the signaling and communications people to design systems to fill these needs. This, coupled with the ever increasing pressure to provide a better return on investment and greater utilization of capital equipment, will bring about more and better methods of centralized control and consolidation of mainline operations, as well as greater refinement and better utilization of yards and terminals. Accomplishing this will require more automatic control equipment and systems which will, in addition, monitor and eliminate the human judgment errors which detract from safe and reliable operation.

Because of anticipated improvements in track conditions, coupled with the increase in the demand for services, it will be possible to increase the speed of trains, particularly passenger trains. Already certain "corridors" and other selected routes have been upgraded and trains are running at high speeds. There are strong indications that many more areas will be similarly improved and that speeds will be even higher. Through this increased speed, for both passenger and freight trains, and with better car utilization and other factors, the railroads of the 80's will move more passengers and more freight with greater efficiency and satisfaction than ever before.

Increasing train speeds will require a review of the systems now in place to determine if they provide the necessary controls for such operation. System modifications and upgrading will likely be required.

There is increased discussion, and it now appears to be a likelihood, that certain railroads in this country and Canada will be converting from diesel electric power to electric power. Because of the size of the investment, and for other reasons, this proposed conversion is being studied very carefully.

Electrification is not new to this country and some of you have been involved with it for many years. To others, this will present new challenges and new problems of design and installation which, for the most part, will have to be made under traffic conditions. The change to electrification will present opportunities to review control systems with a view to providing on board train control and to eliminate wayside automatic block signals.

For the past year or so, we have all experienced and have been expected to solve some of the problems associated with the energy crisis. The situation was quite critical in February and March of this year, not only for you and me as individuals, but for many of the railroads that were trying to keep their operations going.

The situation is much improved now. However, we are still left with two basic problems. First, the supply of fuel is still not in abundance and we must find ways to conserve what is left. Second, the price is much higher. So in considering both these factors, our managements will be requesting us to give them systems and other operating aids which will yield better utilization of motive power, and thus, less fuel consumption by getting the trains over the road and through the terminals with less delay.

Another major consideration for the railroads in the 1980's is that of ecology. As the population increases and it becomes necessary for us to work and live in close proximity to each other, we create disturbances for each other. It makes little difference whether the ecology problems are those of air pollution, impure streams or other pollution on the countryside, everyone who is contributing to the problem must get involved to help correct the situation. The railroads have always recognized their responsibility and have responded to matters such as this.

A further concern for the railroads in the future is the planned conversion from the "customary system of measurements" to the "metric system of measurements." As you know, this change is to take place over a period of 10 years or so. It is quite logical to assume that some things on the railroad will never be changed—such as the gage of the rails, for example. However, many things will change.

By necessity, much of the equipment furnished to the railroad must be rugged and provide service for many years. Because of the long life and low replacement requirement, conversion will go at a slow pace and we will probably not see a complete conversion in most of our lifetimes. However, as more and more of the industries change, the supply of semi-finished and finished materials will no longer be available to the suppliers of your equipment and anything new will have to be made to the metric measurements. The entire matter of conversion will create many problems for the suppliers and the users. It is one which will require good planning and a cooperative effort by all concerned.

Metrification does not bode all evil, however. It will help provide a basis for accelerating the standardization of hardware and equipment; a standardization that is sorely needed in this era of rapidly rising costs. Standardization is a key factor that weighs heavily on the cost of the equipment you buy.

Now that we have touched on some of the major considerations and the likely environment of the 1980's, let us speak more specifically on the signaling and communications control systems as we know and deal with them every day.

Classification yards and terminals

The past ten years have shown tremendous progress in control systems and processing of cars through major terminal areas.

Newer operating and organizational concepts, together with the introduction of the digital computer and other sophisticated equipment, have provided us with the tools, and thus the opportunity, to increase operating efficiency to a new high. We have come to realize that the criteria for yard and terminal design cannot be concerned solely with the physical layout, but must also include the design of the organization and operating plan. In other words, terminal design and implementation standards must be developed as a total system with the functions of signaling and communications, operations and data systems all playing an integral part.

At the present time, there are over 130 hump yards in Canada and the United States that switch and classify cars by gravity. Since only a relatively small number of these are now equipped with modern control systems, it appears that in the coming years, and certainly in the 1980's, there must be an upgrading of many of the older but strategically located yards. There are an additional 1500 flat switching yards that employ at least one switching crew per day. Some of these flat switching yards will be changed to hump yards and, logically, as traffic patterns change, some new hump yards will emerge.

It is also reasonable to assume that the construction of new yards or upgrading of others will cause the elimination of a number of adjacent smaller flat switching yards.

From a more specific viewpoint, there will be a trend to provide high production yards and to include and automate more and more of the functions related to the operations of the terminal area. Automated information systems, which tie the operations of both flat and hump yards into central data systems, will become common.

For the past forty years, centralized traffic control has been one of the major contributors to the improved efficiency and safety of mainline railroad operation. CTC evolved rather slowly at first. During World War II, when the tremendous burden of transportation was cast upon the railroads, the benefits of CTC were quickly recognized and installations were made at the rate of approximately 1500 miles a year. Today, there are over 50,000 track miles of CTC in the U.S. and Canada and it is not uncommon to have 500 miles of single track territory controlled by one operator.

Because it has, and can continue, to do so much to improve training operations, there will be a continuing need to equip new territories and expand others with CTC.

There will be consolidation of existing sections and relocation of dispatchers to one central point. Some of this has already been done or is being planned.

Those persons who are working closely in the area of data system projects will recognize that the 1980's will employ more widespread use of computers to aid in handling functions now performed by the dispatchers. Already computers are being applied to perform the control and indication logic and information storage functions associated with the Central Office portion of the CTC system. The next obvious step will be to utilize the computer's capability and enlarge the office system to handle automatic dispatching, event storage and recording, train identification, train location and performance, crew information, and other

"technology has been moving rapidly, and it will continue to advance even more rapidly."

functions of a purely clerical nature. The enlargement of the CTC system in this manner will enable the operating people to more effectively plan and direct the increased volume of train movements.

The need in the future to increase the speeds and number of trains, will surely enlarge the accident hazard and will necessitate more and better train protection. The Interstate Commerce Commission order dated June, 1947 required the installation of cab signals or automatic train stop or train control systems on such portions of lines where trains were operated over 79 miles per hour.

It was recognized then, that such systems would not only offer better protection for high speed and high density areas, but for all mainline operations throughout the country.

It can be assumed, therefore, that within the next decade, the railroads must reappraise the mainline operations and consider the installation of cab signals and/or train control systems in order to maintain the operation and safety performance we have already attained.

Mass transit systems

The past 10 years have shown us outstanding progress in transit system signaling and communication technology. Heretofore, the train operator was expected to control his train to maintain desired headway and overall performance to schedule. Tower operators were also expected to perform their duties so that delays and other problems were avoided. As more and more demands were being placed on the systems, the human judgment factor in the operation became inadequate and the need for more automation became evident.

Arising from this great need to improve mass transit operation, there are now available in systems being installed, features that provide automatic train operation, automatic train control and automatic train protection. Functions such as cab signals and overspeed control, speed regulation and station stopping, and door control are included.

Additionally, sophisticated train-to-wayside and wayside-to-train communication channels are included to provide constant communication between the central office and the train during the entire run.

Central control offices are being equipped with computers and peripheral equipment which effectively communicate with wayside locations and then process data which provide train performance adjustment, schedule modification, alarms of malfunction conditions, and a host of similar data, all of which allows the operating people and the system to give better and safer performance.

During the 1980's there will be a continuing trend to provide systems of this nature and which utilize computer hardware and software to an even greater extent as an aid to managing the operations.

Highway crossing systems

In the past five years there has been much activity in the Highway Crossing aspect of railroading. There is increasing attention being given by federal, state and local government officials concerning the large number of unprotected grade crossings and definition of what should constitute adequate protection of such crossing in a given environment.

The National Grade Crossing Inventory and Numbering Systems program, scheduled for completion in June, 1975, takes a big step towards defining this problem.

There have been significant changes and developments in highway crossing technology in recent years, such as motion detection devices, crossing approach predictors, logic and power devices and also improvements in crossing signals, gate mechanisms and their supporting hardware.

All of these have contributed to improved safety, operation and flexibility, as well as providing advantages in cost, installation and maintenance.

Because of the need to protect more grade crossing and with the aid of governmental funding for highway crossing systems, there will be a continuing trend through the remainder of the 70's and into the 1980's to install more crossing protection systems. The problem now is for the individual states to set their crossing priorities, select projects for improvement, and apply for the available funds so the job can be done on a timely basis.

Radio communications

When we consider the application of computer technology with resultant capacity to receive and depict real time information, we should recognize the role of railroad radio.

Radio and microwave communication will be used more effectively and broadly for data transmission, particularly for information reporting and monitoring. We envision many product applications for real time control, monitoring and measuring performance where short digital messages may be transmitted over existing communication channels. Certainly the very efficient method of controlling locomotives from a ground location should be considered and applied on Class I railroads in much the same manner as now applied to industrial railroad properties.

As you know, many changes are occurring that call for better dispatcher to train communication systems. Because of more and faster train movements, fewer way stations, constantly changing traffic patterns, increasing centralization of traffic control, and the absolute economic necessity of achieving better equipment utilization, the need for such systems has become a critical item in railroad operations. These systems, which provide instant communications between the dispatcher and crew, will see a phenomenal growth during the next decade.

Summary

To summarize, I would like to restate what I said at the beginning. That was —the past thirteen years have seen more changes in railroad signaling and communications than have occurred in the previous 75 years.

The fact is, technology has been moving rapidly, and it will continue to advance even more rapidly.

The railroads have always been an industry where innovation has constantly occurred. We must continue to bring new things into use and strive for improvement. However, we must always consider the good from the past and add new state-of-the art technology when we determine it can do the job at the price we can afford to pay.

The railroads in both Canada and the United States perform a vital role in their respective economies. They operate in a very competitive environment. There will be many opportunities in the 1980's for us in signaling and communications to continue to provide safe and reliable systems that will yield efficient and therefore, profitable operations.

The future of data systems

Over the past decade the railroad industry has invested an estimated $150-200 million in developing and installing computer-based systems to support more efficient control of the nation's car fleet.

Not only is this an impressive achievement in dollar terms, but also in the capability of the resulting systems. It is thought that the railroads are among the most sophisticated large industrial users of computer technology today.

Although the role of the computer in the railroad industry is significant, it is still in its infancy. What does the future hold for data systems, as applied to the railroad industry? What systems will be developed? How and when will these systems evolve. These and other questions are carefully discussed in the following paper which was presented by J. W. Germany, Vice President, Information Systems, Southern Pacific, at the recent annual Data Systems Division, AAR meeting in Atlanta, Ga.

J. W. Germany, Vice President, Information Systems, Southern Pacific.

In looking at future systems that are either on our drawing boards or that we have thought much about, there are many areas that may be considered. Car scheduling, car distribution, service evaluation, rate making, market analysis, costing, train dynamics, yard and terminal activities and computerized train dispatching are a few of the areas we might discuss and there are many more.

Rather than talk about specific future systems, it seems more appropriate to talk about how we might get to future systems. Of major importance are the questions of:

1. What systems are we going to develop?
2. How will the system be developed?
3. When?

Certainly our industry now faces challenges much different than during the past ten years of computerization. With the close competition for both capital and operating expenditures, we must assure ourselves that proposed computer expenditures meet the most important needs of enhancing the railroad's ability to survive economically and functionally. Many of our past activities have related to cost reduction which while important no longer can be considered as the major portion of our future systems.

The first question is: What systems shall we develop and in what priority order? I am sure that each of us in the computer activity have faced a question of priority decisions. But more important than establishing a priority is developing the menu of requirements that represent the best that can be performed with computerization for each of the individual departments of the railroad. It is this area that must command our greatest amount of attention for our future systems.

Through close cooperation and coordination with each of the individual departments of the railroad, we must make certain that we are aware of the critical issues faced by those departments in their future planning. With an awareness of their future problem areas, a careful analysis must convert their problem areas into computer applications that can assist in reaching their individual goals and objectives. As with any planning process, this must become an iterative process with continual dialogue between the computer department and the using department. Only through this iterative process can we make certain that our system design is addressing the proper problems and is producing tangible results for the using department.

While moving through the process of developing departmental requirements, we must also assure ourselves that inter-departmental requirements are covered in our future systems. During our growth period in the industry, computerization was developed primarily on a parallel functional basis with systems being developed for each of the individual departments. We now find that the data bases for the individual departments are not necessarily departmental data bases and our requirements require the combination of data elements to serve inter-departmental functions. I think we all realize that data bases for the future will be less function oriented and more corporate oriented.

If our future system development has properly gone through the process of establishing the computer goals and objectives and properly scheduled priorities for future development, our next problem area becomes primarily an internal function of the computer department to determine how systems will be developed.

In this area we, as computer specialists, must reevaluate our own internal activities as they relate to future development.

Many of our past activities have related to external factors such as the development of new hardware technology or to the release of new software, giving capabilities that we found we could exploit. In many cases these external factors generated new internal systems. This was a proper chain of events, given the technological developments in computerization and the needs of our industry. The future seems, however, to dictate more of a requirement to have future developments occur as a result of our internal needs. Hardware and software, I think we can be assured, will be provided by the vendors to accomplish the tasks ahead. We need only to make our requirements clearly known and study the releases by the vendors, selecting those new developments that most clearly fit our new requirements and rejecting those that have no clear benefit in our activities.

We also must recognize that our computers and computer specialists represent an expensive resource whose maximum productivity must always be our objective. Too often our thoughts have been concentrated on improving resource utilization in other areas of

(continued on pg. 18)

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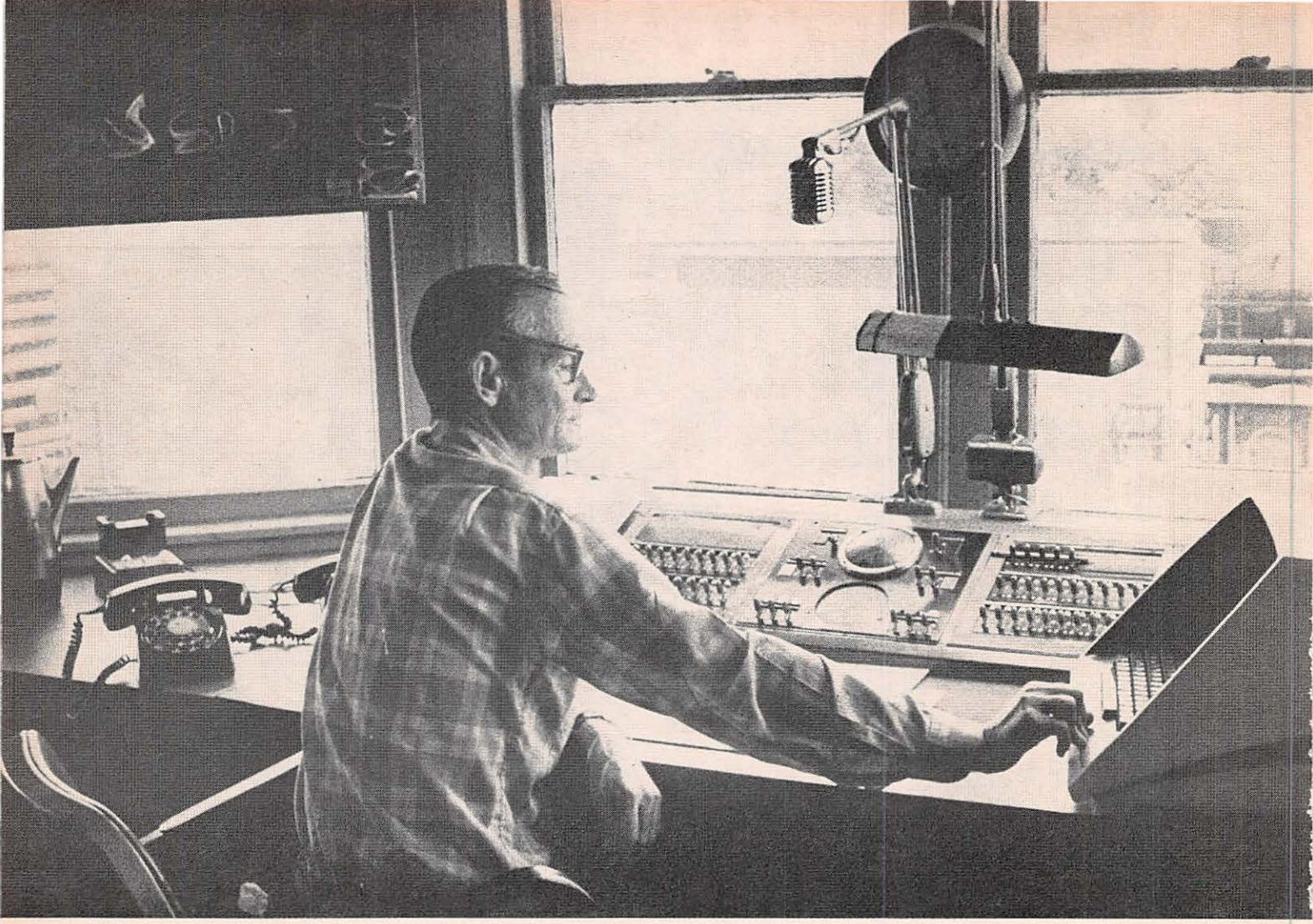


MoPac control system speeds

"We can now switch a freight car in a computerized yard in less time than it used to take just to find a record of where it came from and where it was going," says G. S. Sines, director of an extensive Transportation Control System (TCS) project for the Missouri Pacific. TCS is MoPac's break with history by controlling car, train, and terminal operation with computer-based techniques.

Data on inventories and movements of cars for the entire system are maintained in an IBM 370/168 computer at MoPac's St. Louis headquarters. Movement data is then transmitted to and processed on minicomputer subsystems in individual yards which provide car information on demand to support switching operations. At the yard level, MoPac has developed a standardized Yard and Terminal Subsystem (YATS) which ties in with the overall TCS network.

TCS, Sines explains, is an enhancement of the data communication network originally used to transmit car movement data for central computer processing and to dispatch lists to affected yards. Ultimately, the data network will be fully automated, with direct communication taking place between minicomputers in 22 major terminals and the large central system in St. Louis.

Even in its first phase, however, YATS has produced substantial improvement—more than enough to offset the cost of computerization of car information processing at the individual yard level. In addition to creating additional revenues, Sines cites improvement of service to shippers as an important result of the innovation.

The first terminal to have a YATS system operational, Sines says, is MoPac's Memphis facility. The class yard has 63 tracks and an average of some 2,000 freight cars handled, illustrating the point that information about equipment, facilities, and inventory control is beyond the scope of efficient manual sorting and processing.

Under the new approach, 22 major terminals in the 12-state MoPac system will be served by a PDP-11/40 minicomputer supplied by Digital Equipment Corporation, Maynard, Mass. Depending on volume of traffic and the amount of backup that is required at a YATS location, one of three basic hardware configurations will be used.

1—The first configuration is for a small to medium size terminal which may include one to four or five small yards with an average inventory of 1,000 to 2,000 cars. This configuration includes one DEC PDP-11/40 minicomputer with 48,000 16 bit binary words of memory and on-line disk storage capacity of 7.5 million characters spread over three disk drives.

2—The second configuration is suited to a large terminal again covering several yards with an average inventory range of from 2,000 to 8,000 cars. In this configuration the critical hardware components of the system are duplicated for back-up protection. This system is made up of one PDP-11/45 (prime) and one PDP-11/40 (back-up). Two 40-million character disks (prime) and one 40-million character disk (back-up) with 80,000 to 96,000

William Rasbach, PICL clerk (left), and J. T. Ransome, assistant PICL clerk, can check status of tracks or individual cars through references to computer files. YATS file references at the office of MoPac's Memphis yard are handled on two CRT video display terminals.

Leonard M. Dunham, assistant general yardmaster, uses a CRT terminal located in the yardmaster's tower at MoPac's Memphis yard. By using the terminal, he can obtain information from track and car records and also enter switching instructions.

inventory and movement

16 bit binary words of memory.

3—The third configuration is the same as No. 2 with hardware added to support a remote YARD some distance from the terminal complex. To do this a remote PDP-11/10 with 16,000 words of memory is installed at the remote yard to support local peripherals and communicate directly with the prime system line.

The computer installation in the yard office includes capabilities for high speed line printing and for reading and punching of data cards. Equipment also includes cathode ray tube (CRT) video terminals in the yard office and the yardmaster's tower. The tower also has a Receive Only printer for listing of train and car information. Switching shanties throughout the yard have been equipped with Receive Only (RO) printers for producing switch lists for classifying cars.

The disk units of the PDP-11 computer system store operating programs, communication control software, and several critical data files which provide information necessary for yard operations and control under the YATS approach.

The car files are organized according to car number. A separate record is maintained for each car in the yard or on its associated track. Information on each car includes car number, track on which it is situated, position on the track on which it is located, type of car, contents, destination, consignee, switch handling code, industrial spotting information, and any special handling codes which are appropriate (perishable cargo, etc.).

The track files contain lists of car numbers, in sequence for each track in the yard.

In using the computer files as a working tool, the yardmaster uses his CRT terminal to call up information on individual cars or blocks of cars as switching decisions are to be made.

For each car, the yardmaster decides either to let the switching proceed on the basis of computer-assigned destinations or he can override the system by entering instructions into the keyboard of his CRT terminal. In most cases, Sines points out, switching is routine, because the computer will automatically determine to which tracks the cars should be switched on the basis of destination data in the car records. However, the ability of the yardmaster to override as required for emergencies, changes, or special situations was considered mandatory in the design of the YATS system. Under this approach, the yardmaster is seen as a manager of resources and operations. Routine procedures are handled by the computer, leaving the yardmaster free to apply his experience and judgment to situations requiring his attention.

In each case, the yardmaster decides to accept or change the switching instructions for each car. These decisions are implemented with entries through the keyboard of the CRT terminal in the tower. The PDP-11 minicomputer then initiates a message to the printer in the tower and the appropriate switching shanty. This list provides the information that is necessary for the switchman to switch the cars properly.

The information processed by the

Hub of MoPac's first YATS installation in the road's Memphis facility is a PDP-11/40 minicomputer. William Rasbach is reviewing a report printed on a high-speed line printer.

YATS systems within individual yards comes from three sources:

1—Dispatch information on trains moving over MoPac lines is received on punched cards over data transmission lines directly from the central computer in St. Louis. One card is created for each car. Cards are received and maintained in the same order as each car's position in the train. These cards are entered into the PDP-11 minicomputer when word is received that the train has arrived at the yard.

2—For inbound trains from "foreign" lines, waybills are used in the receiving yard to punch car cards.

3—For trains or groups of cars received from industrial areas, yard office personnel punch car cards.

All cards are entered into the PDP-11 computer as trains or switch engines arrive at the yard. Thus, the car and track files represent a cross-referenced inventory of the yard at any given time. In effect, the computer disk units replace the PICL (Perpetual Inventory Car Location) pigeonhole files used under former, manual yard control systems. Computerization multiplies speed and enhances accuracy substantially.

When a train departs Memphis, the PDP-11 minicomputer triggers the card punch unit within the YATS system to generate a deck of cards, one each, in order, for every car on the train. At the same time, the car records are deleted from the PDP-11 disk files.

The cards for the outbound train are then transmitted to St. Louis, where the data is entered into the central computer. The central computer, in turn, generates a new deck of cards for transmission to the next destination yard for processing of the train on an inbound basis.

"Ultimately," Sines says, "the cards will be phased out. Data will be moved at high speeds from the central computer to the YATS units and information originated at the yards will be entered on CRT terminals and processed directly by computers. At this point, we will be able to use the central computer for scheduling of all cars in the system on a coordinated basis.

"The ability to computerize yard operations is a vital element of this bright future picture. Freight yards are run by railroad men, not computer technicians. We wanted a system which dovetailed with routine railroad operations. YATS accomplishes this. Yard office personnel have been able to adapt to the YATS system with only nine hours of special training. If computer problems develop, technicians can patch in from our St. Louis headquarters and perform the necessary diagnostics. Under this approach, computers are a tool for the railroad, not vice versa."

The future of data systems

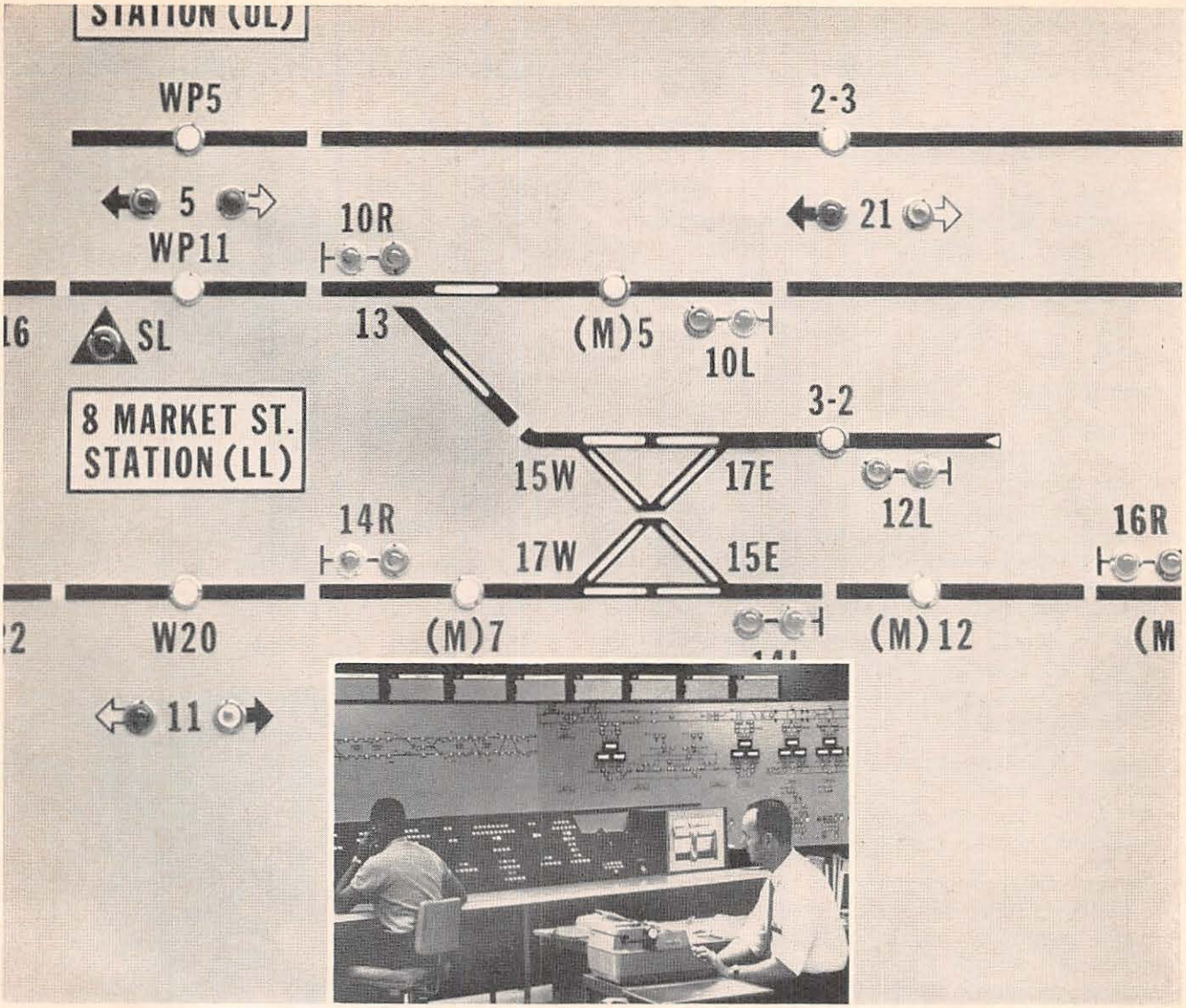
(continued from page 14)

the railroad without looking internally at the resource represented by our own activities. In developing the method for implementing systems of the future, we must include programmer productivity as an important ingredient in how systems will be developed. Our long range objective should be to provide systems capable of user direct interface, bypassing the programmer and the time necessary for program development.

Having looked at the two elements of what systems should be developed and how they should be developed, the remaining question of when the development should occur poses our next problem.

Computerization must take its place in line along with other capital and operating expenditures of the railroad. Return on investment must be an important criterion in determining when expenditures will be made for computerized activities. To get to future computerization in the minimum time frame, we must assure ourselves that our developments are not gold plated. In the development period of computerization in the industry and in fact in all industry, experience has indicated time and financial overruns of 100% are not uncommon. Using the experience of the development period, we have learned much that gives us the capability to more accurately estimate the development time and costs. With the development of a high degree of confidence level in our cost and time estimates of future system development, we will find a new level of management confidence in approving expenditures.

My emphasis here has been primarily on the development of computerization within each individual company comprising our industry. Certainly future system development will have greater industry-wide implications. The same process used for deciding what should be done in computerization, how it will be done, and when, certainly apply equally well to the industry activities. It is certainly desirable in the Data Systime Division, working with other divisions of the AAR, to follow the same general guidelines in establishing the goals and objectives for industry-wide computer activity and for those goals and objectives to become the dedication of the Data Systems Division. Data exchange between and among railroads must be included in our future goals and objectives and must move from the drawing board more into our daily routine.



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2. Definition:
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3. Symbol: None

4. Description:
There are various types of primary battery systems which make use of automatic rectifiers for track and line circuit applications. The rectifier shown in Fig. 1 is usually used in track circuit applications in multiple (parallel) with primary battery to supply most but not all of the current required by the load. Some small drain on the battery is required to keep it in active condition. The transformer used in the assembly is designed to cause the rectifier to automatically assume practically all of an increasing load current within the rated current limits of the rectifier.

The taps on the transformer, or a combination of transformer taps and a sliding core, permit adjustment to be made to obtain the desired division of load between the battery and the automatic rectifier.

There are also constant current rectifiers used primarily for line circuits. This type of rectifier, Fig. 2, can be used to energize dc line relay circuits directly, which is the system generally employed when primary battery furnishes the reserve source of power.

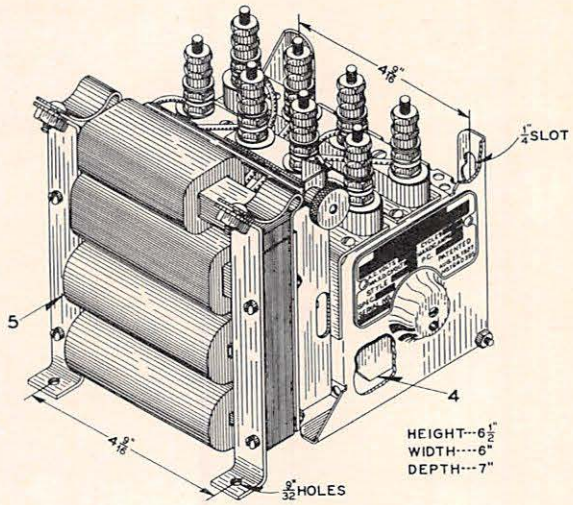

Fig. 1

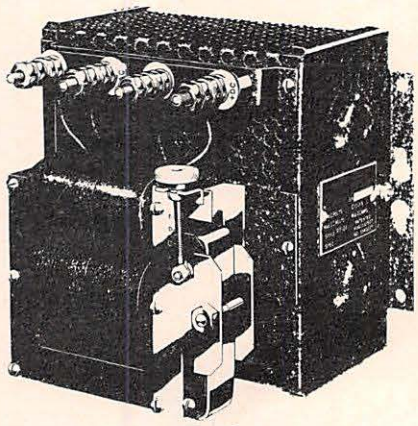
Fig. 2

5. Purpose and Application:
Methods for using rectifiers shown in Fig. 1 and Fig. 2 are illustrated in schematic drawings, Fig. 3 and Fig. 4. The rectifiers are connected in multiple (parallel) with the batteries, the rectifier being adjusted to carry the normal connected load, thereby extending the service life of the battery.

6. General Information:
Provision should be made to allow a few milliamperes of current to flow from the batteries under normal load conditions to maintain the battery in an active state. Generally, rectifiers designed for this application automatically adapt current output to the load requirements and when properly adjusted will supply all the load current except the few milliamperes which the battery must supply to keep it in an active state. For alternate method of keeping battery in active state, see Note 3, Fig. 4.

7. Detailed Operation:
Adjustment for type shown in Fig. 3: This rectifier should be adjusted with the average ac voltage which occurs at that location applied to the rectifier ac terminals. Average voltage means the ac voltage which is approximately midway between the maximum and minimum line voltages which may occur at that location. Insert dc ammeters of the permanent magnet type in both the battery and the load circuits, as shown by dotted lines in the diagram of Fig. 3. (Caution: Do not open ac power supply after inserting the ammeter in the battery circuit or the ammeter may be damaged.) If the polarity of the ammeter in the battery circuit is as shown in the diagram, the current read will be that furnished by the battery to the track circuit. Loosen the clamping device at the top of the transformer until the sliding block may be shifted; however, keep sufficient pressure on the block to hold it in contact with the transformer core. The "in" position of the block corresponds to low line voltages, and the "out" position to higher line voltages. To adjust the track circuit current, connect a 12 ohm resistance unit across the track; vary this resistance and the series resistor of the track circuit while also shifting the block until the battery discharges at the value shown. Hold this adjustment of the block by tightening the clamping device, making certain that this tightening operation has not altered the battery output. The adjustment is now complete and the series resistor should be restored to its normal value and the track shunt removed. Check that battery is discharging at not less than 0.010 amp; then remove ammeters.

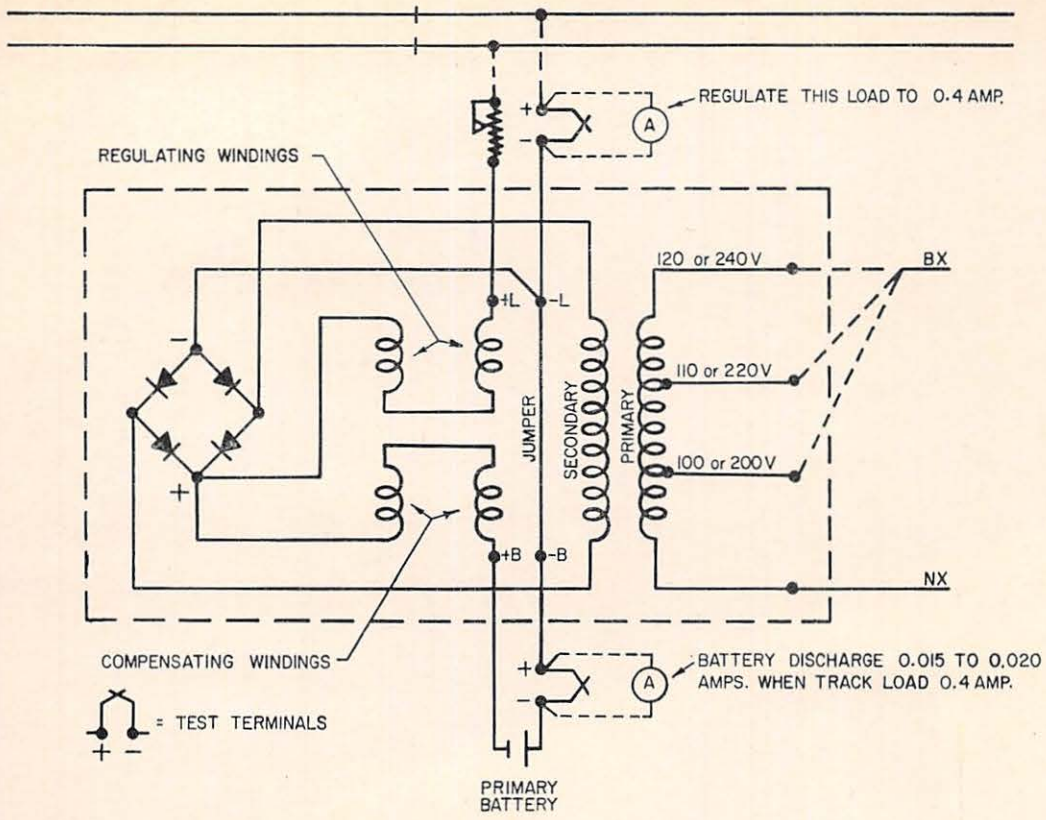

Fig. 3.

Automatic rectifier for track circuits.

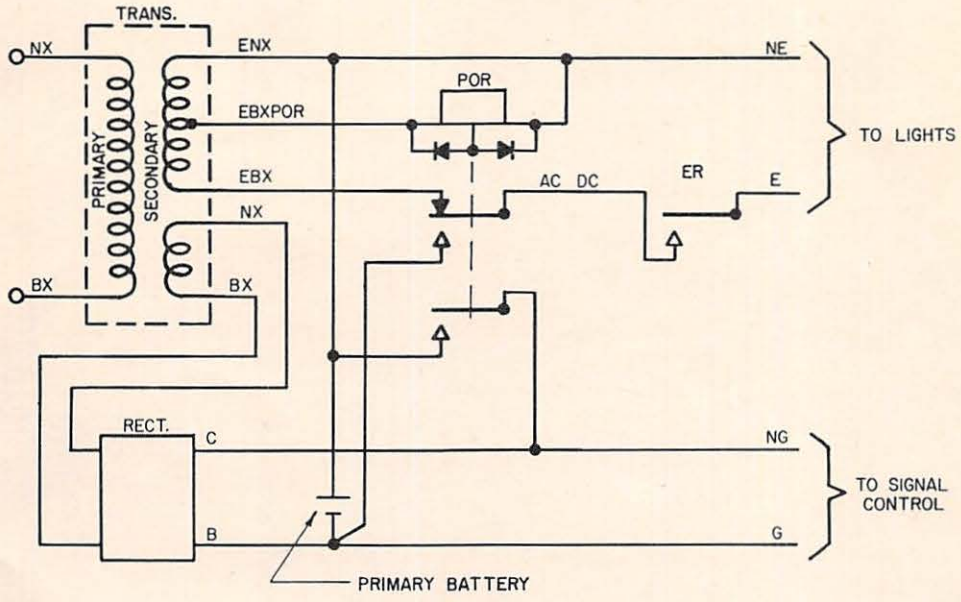

Fig. 4

Primary battery system with rectifier—a typical power arrangement for light type signals using primary battery.

Note:

1. Adjust transformer to provide 10 volts ac on terminals of "POR" when ac supply voltage is at normal high level.
2. Rectified voltage is to be adjusted in field to a potential (within 2 volts) of adjacent line batteries using same common wire, but not less than 10 volts with normal load.
3. Place a restrictive shunt of approximately 0.5 ohm across battery for 10 minutes each 30 days to keep battery in active condition. An alternate method is to connect a 125 ohm fixed resistor across the battery to provide a minimum constant drain to keep battery active.

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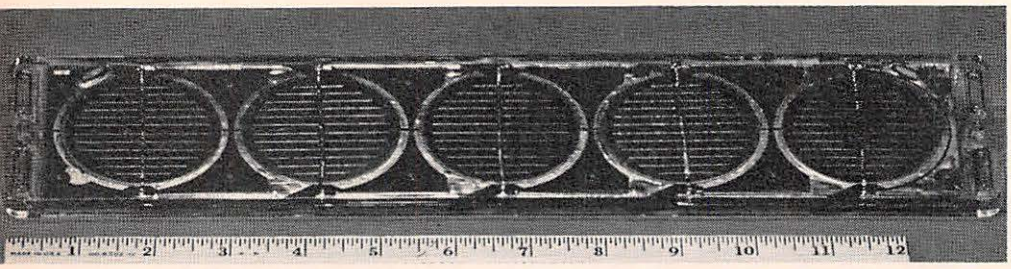
Southern's sun powered grade-crossing installation is located about 12 miles southeast of Atlanta, Ga.

The sun powers a Southern

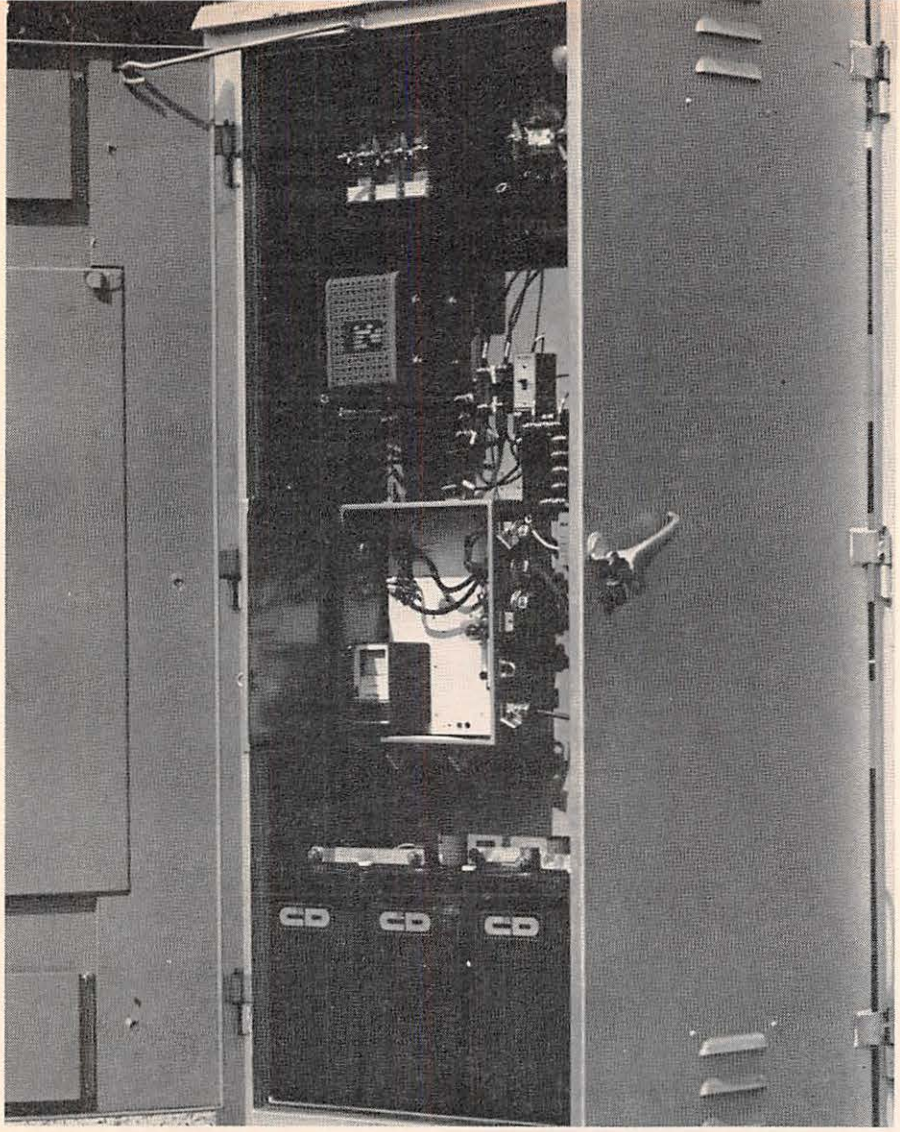


A standard module, as manufactured by Solar Power Corp. consists of five 2.17-in. wafers, wired in series or parallel. The wafers are constructed on glass-reinforced printed circuit board which is anchored firmly by 12 corrosion-resistant screws into an impact-resistant polycarbonate case. Each module is capable of producing up to 1.5 watts of power.

Energy from the sun is working full time (during the daylight hours, that is) to supply power to one of Southern's automatic grade crossing warning systems.

Solar cell development was very slow in its infancy, but many of the cost and manufacturing problems have now been overcome. It is expected that the railroad industry will see increasing use of the sun's energy for supplying electricity in a numer of areas.

In the signaling field, pilot installations are already being studied for the long term use of solar cells. In December 1973 the Canadian Pacific installed a solar array near Montreal to power a DC track circuit. A similar array is operating on the Seaboard Coast Line near Jacksonville, Fla., also to power a track circuit. In addition to Southern's grade crossing application, another array was recently installed near Slidell, La., for a center feed track circuit.



Along with standard hardware, the bungalow houses a test chart recorder.

grade-crossing signal

Southern's grade crossing installation, just outside of Rex, Ga., or about 12 miles southeast of Atlanta, is at a typical railroad-highway crossing, protected by flashing light signals to warn drivers in either direction on the intersecting two-way highway. Typical—except for one unusual feature—a 45 sq. ft. array of silicon solar cells which supply all charging power for the bank of 1368 AH, 12 volt, lead-acid batteries.

According to Southern engineers, the solar array was installed early last September for a thorough evaluation of the possible use of solar cells as a power source for some of Southern's remote grade-crossing installations. Commercial power can still be switched in to charge the batteries if the solar charging system fails to maintain sufficient charge, though this problem has not so far arisen.

The solar array—developed by Solar Power Corp. of Braintree, Mass.—is made up of 119 modules, each capable of producing up to 1.5 watts of power. A standard module, as manufactured by Solar Power Corp. consists of five 2.17-in. wafers, wired in series or parallel, constructed on a government specification glass-reinforced printed circuit board which is anchored firmly by 12 corrosion-resistant screws into an impact-resistant polycarbonate case. The board is encapsulated with clear silicon rubber to maintain a mechanically sound, hermetically sealed unit. The unit, or module, measures 13.63 in. by 2.92 in. by 0.32 in. The terminals are machine threaded, corrosion-resistant brass. Mounting holes are located on each end of the module. This package, or module, has enabled the solar cells to function under various conditions. According to Solar Power Corp., the package must be able to withstand shock, vibration, moisture, humidity, and a certain amount of vandalism.

Site requirements

Since power requirements for any particular installation may vary according to the amount of sunlight in the area, Solar Power Corp. has developed computer programs for calculating the requirements based upon both the power needs and the weather records of a particular area. The batteries are subject to a daily cycle of charging during the day and discharging during the night. In addition, there is an annual cycle of gradual discharge during the winter months when power requirements may exceed the amount available from the solar array, followed by a gradual return to the fully charged state during the summer months when the amount of power generated by the solar modules exceeds that required by the load. Specifications for the Southern installation took the following load conditions into consideration:

Crossing unoccupied—2.0 Amps—23 hrs/day (overlay)—46 AH/day.
Crossing occupied—6.0 Amps—1 hr/day (light & bell)—6 AH/day.

After considering the average weather conditions in the area, specifications for the solar array were made as follows:

12.0 Volts dc Nominal
10.2 Amps Maximum
119 Modules (plus 1 spare)
Dimensions—108 in. by 60 in. by 4 in.
Weight—300 lbs.
Battery—1368 AH, 12 Volts dc, Lead-Acid type with Lead-Calcium plates.
Cost of assembled array and battery—under $8000.

For comparison, the manufacturer points out that for a similar crossing installation where the continuous current drain is only 0.6 amp., the system cost would be less than $3000.

Maximum exposure

The solar array is mounted in a fixed position that gives maximum exposure to light. Ideally, for maximum power output, the array should track the sun, but the energy used to operate the tracking device would more than offset any gain in array output power. According to the manufacturer, the best fixed position for an array is facing the equator at an angle to the horizontal equal to the latitude plus five degrees. The angle may be increased to favor operation during the winter months.

Long-life rechargeable storage batteries of either the lead-acid or nickel-

cadmium type are used. The batteries may be capable of recycling and have a very low self-discharge rate. With no moving parts or deteriorating chemicals in the solar cell modules, maintenance requirements are substantially reduced, and life expectancy is more than 15 years.

Another attractive area of solar cell application is for powering remote radio repeater stations. Due to the low power requirements of VHF repeater stations, solar cell application should have increasing use in this area on the railroads.

The silicon sun-power trap

(Excerpts from a speech given by Ellis E. Walker, Senior Marketing Engineer, Solar Power Corp., at the 1974 Annual Meeting of the C&S Section, AAR, Atlanta, Ga.)

Silicon solar cells are fabricated from a cylindrical crystal of nearly pure silicon (Si), the second most abundant element on earth, which is grown from a hot melt of silicon. The crystal is usually doped with a small concentration of impurity so that it will conduct electricity, as pure silicon is a poor conductor. Depending on the nature of this impurity, the crystal will conduct negative (n) charges (called electrons) or positive (p) charges (called holes). Phosphorous may be used to make the crystal n-type and boron to make the crystal p-type. The n or p type cylindrical crystal is then sliced into very thin wafers.

The next step in the manufacture is to make a p-n junction. For example, if an n-type wafer (phosphorous impurity) is used, boron is diffused at high temperature into its surface to such an extent that a thin surface layer becomes p-type.

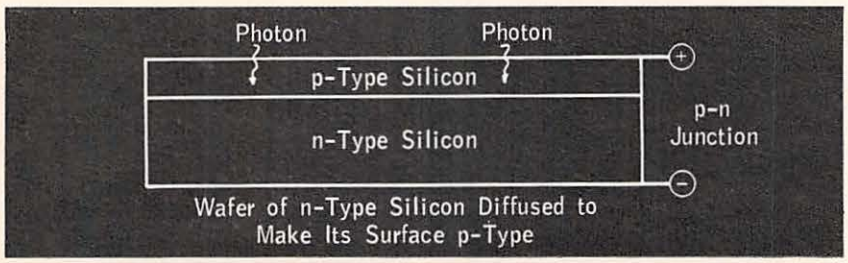
When a photon from the sun strikes near the p-n junction region a negative charge (electron) and a positive charge (hole) pair is produced. The electron will tend to travel toward the n-type silicon and the hole will tend to travel toward the p-type silicon. If wires are connected to the p and n regions, this electricity can be made to flow in an external load to do useful work. Each wafer can develop about 0.4 to 0.5 volts in sunlight.

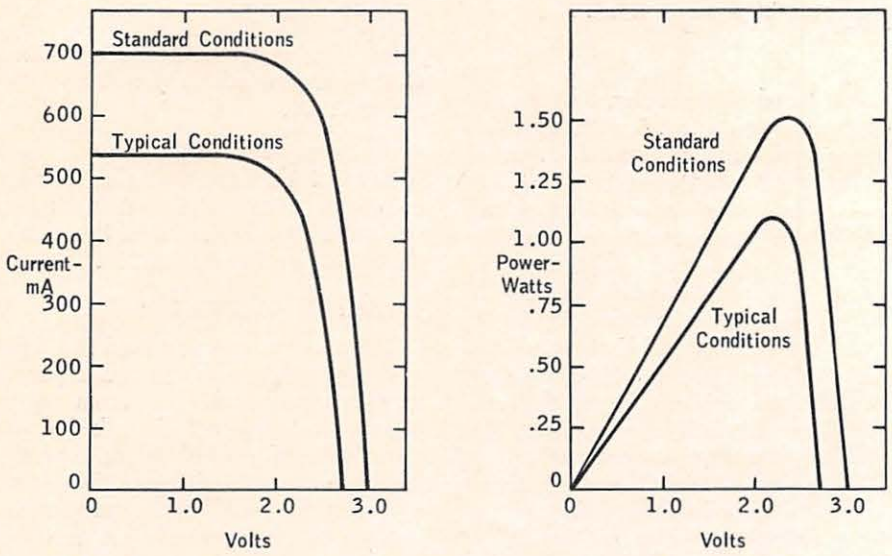
The solar cells are assembled into a package or module that will permit them to function in an earth environment. The package must be able to withstand shock, vibration, moisture, humidity, and small boys throwing rocks, among other things.

The electrical output of each module under maximum light conditions is 1.5 watts. The series connected module generates 0.65 ampere at 2.3 volts and the parallel connected module generates 3.0 amperes at 0.5 volts. Curves of current vs. voltage and power vs. voltage for the series connected solar module 1002 are typical of the operation of any solar array regardless of size and configuration. At any given intensity level the current vs. voltage curve is flat, up to a predetermined voltage level beyond which the current drops off rapidly. This self-regulating feature prevents any significant overcharging of the battery. The arrays are designed so that maximum power output occurs as near as possible to the desired battery operating voltage. If the battery should begin to go into an overcharge condition its voltage will begin to rise. When this happens the charging current from the array will follow the current/voltage curve and be reduced automatically.

Solar cells themselves have no storage capability. They generate only while exposed to light. Since power is usually required continuously a storage battery is used to provide power during the time the solar array is in darkness. During the daylight hours the array recharges the battery as well as handling the load.

A solar power system consists of a solar array and a storage battery. The array is composed of solar modules mounted on suitable frame with series and parallel connections to meet the design requirements. The number of solar modules in series is determined by the operating voltage of the system. The number of modules in parallel is determined from an analysis of weather data and the load requirement. Built into each array is a blocking diode to prevent discharging the battery back through the solar cells during periods of darkness.





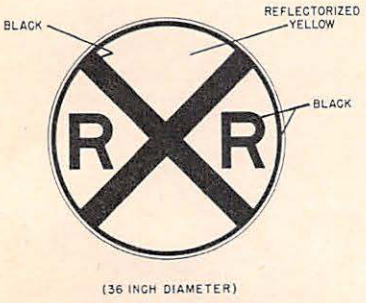
Power vs. voltage and current vs. voltage curves are shown for a typical module at standard conditions and at typical operating conditions. Standard conditions: 100 mw/cm² solar intensity, 0°C cell temperature, sea level. Power output is 1.5 ±.25 watts at standard conditions. Typical operating conditions: 80 mw/cm² solar intensity, 25°C ambient temperature, sea level. Power output is 1.0 ±.2 watts under these conditions.

Recommended practices for grade crossing warning systems

Following is the second part of a two-part series covering the information found in the AAR's recently published "Recommended Practices," Bulletin No. 7. Part one began on page 55 of the September issue of RSC.

Reference to the use of twelve-inch roundels in signals which govern movements over the tracks raised some controversy at the recent C&S meeting in Atlanta. Consequently, the bulletin did not meet with the final approval of all those attending the meeting. A revision may result. RSC will inform the readers of any changes made subsequent to this printing.

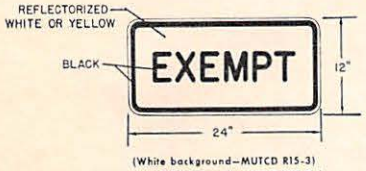
EXEMPT crossing signs are permitted to implement Federal regulations and laws and regulations of various states. The EXEMPT signs, a responsibility of public authorities, eliminate, at certain designated unsignalized crossings, the mandatory stop normally required for certain vehicles such as buses and those carrying hazardous cargo. As an aid to drivers of those vehicles and to drivers following such vehicles, EXEMPT signs may be mounted below the crossbuck and track signs at the crossing, and also below the Railroad Advance Warning sign, at those locations where exemption is authorized.



(36 INCH DIAMETER)

RAILROAD ADVANCE WARNING SIGN

(MUTCD W10-1)

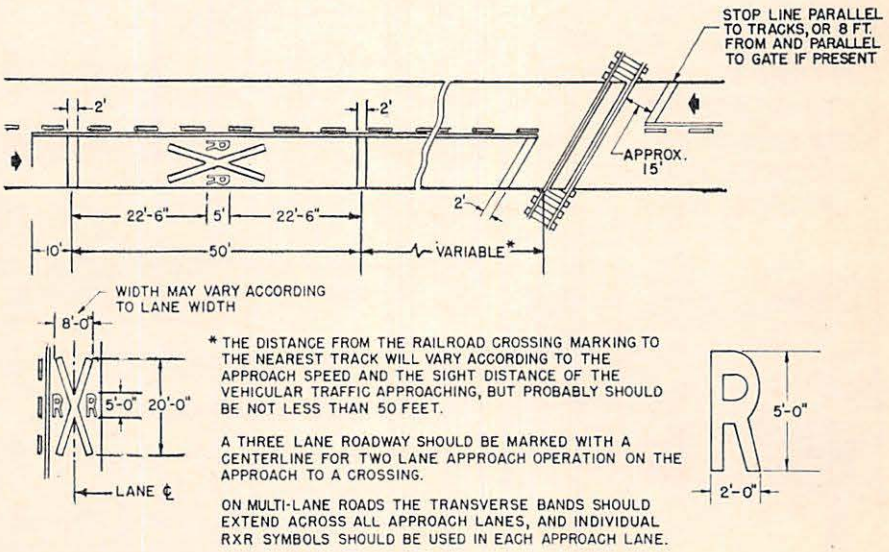


(White background—MUTCD R15-3)
(Yellow background—MUTCD W10-1a)

EXEMPT SIGN

Fig. 2

The standards adopted carry the word EXEMPT in black letters on a white background on a 24-inch by 12-inch plaque (MUTCD R15-3) for use with the crossbuck and a sign of the same size with black letters on a yellow background (MUTCD W10-1a) for use with the advance warning signs. The Railroad Advance Warning sign and the EXEMPT sign are illustrated in Figure 2.


STOP LINE PARALLEL TO TRACKS, OR 8 FT. FROM AND PARALLEL TO GATE IF PRESENT
2'
2'
APPROX. 15'
22'-6"
5'
22'-6"
2'
10'
50'
VARIABLE*
WIDTH MAY VARY ACCORDING TO LANE WIDTH
8'-0"
5'-0"
20'-0"
LANE ℄
* THE DISTANCE FROM THE RAILROAD CROSSING MARKING TO THE NEAREST TRACK WILL VARY ACCORDING TO THE APPROACH SPEED AND THE SIGHT DISTANCE OF THE VEHICULAR TRAFFIC APPROACHING, BUT PROBABLY SHOULD BE NOT LESS THAN 50 FEET.
A THREE LANE ROADWAY SHOULD BE MARKED WITH A CENTERLINE FOR TWO LANE APPROACH OPERATION ON THE APPROACH TO A CROSSING.
ON MULTI-LANE ROADS THE TRANSVERSE BANDS SHOULD EXTEND ACROSS ALL APPROACH LANES, AND INDIVIDUAL RXR SYMBOLS SHOULD BE USED IN EACH APPROACH LANE.
5'-0"
2'-0"

TYPICAL PAVEMENT MARKINGS AT RAILROAD-HIGHWAY GRADE CROSSINGS

Fig. 3

Markings and lane uniformity

Pavement markings as illustrated in Figure 3 should be used on all paved approaches to railroad crossings. Such markings are the responsibility of the public authorities. If physically feasible, they are to be used on all crossings where railroad-highway crossing signals are located and at all other crossings where the prevailing speed of highway traffic is 40 miles per hour or greater. Such markings shall be white except for the no-passing markings. With some exceptions, the UVC restricts passing on two-way roads at or near railroad grade crossings. Section 11-306 reads as follows:

"Further limitations on driving on left of center of roadway

(a) No vehicle shall be driven on the left side of the roadway under the following conditions:

1. ******
2. When approaching within 100 feet of or traversing any intersection or railroad crossing.
3. ******

(b) The stop line may be perpendicular to the roadway and centerline marking may be extended across the track as required.

Width and surface of roadway at a railroad-highway grade crossing should correspond to that of the adjoining highway and have the same number and width of traffic lanes and shoulders as adjoining highway without extra lanes at the crossing.

Railroad-highway grade crossing signals and devices

Railroad Highway Crossing Signals (flashing light signals) which indicate the approach or presence of trains should be installed at those railroad-highway grade crossings where studies by qualified engineers indicate the need of warning beyond that provided by signs and/or markings.

The flashing light signal, when indicating the approach or presence of a train, shall present toward approaching highway traffic the aspect of two red lights in horizontal line flashing alternately. The flashing light signal is illustrated in Figure 4. A number of tracks sign shall be included when there are two or more tracks at the crossing.

At some crossings the flashing light signal may be supplemented by a gate. The gate serves as an adjunct to the flashing light signal and, when actuated, shall present toward approaching highway traffic an arm either being lowered or at rest in a horizontal position across

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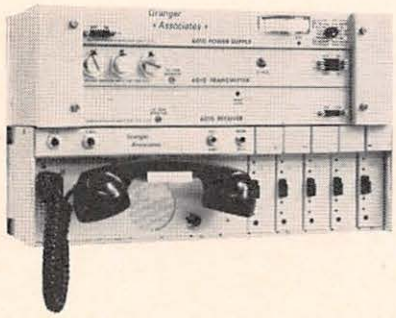

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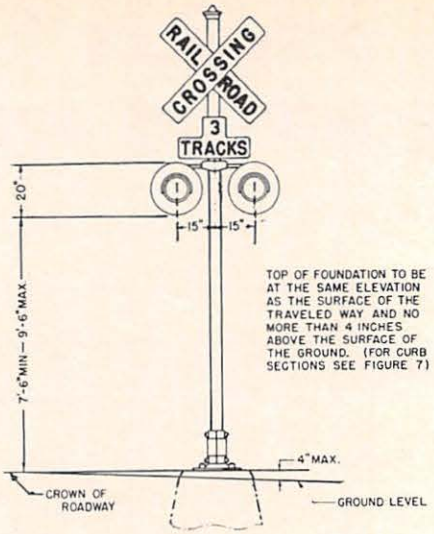

RAIL
CROSSING
ROAD
3
TRACKS
20"
15"
15"
7'-6"MIN – 9'-6"MAX
TOP OF FOUNDATION TO BE AT THE SAME ELEVATION AS THE SURFACE OF THE TRAVELED WAY AND NO MORE THAN 4 INCHES ABOVE THE SURFACE OF THE GROUND. (FOR CURB SECTIONS SEE FIGURE 7)
4"MAX.
CROWN OF ROADWAY
GROUND LEVEL
NOTE: Details shown on Signal Manual Drawing 1653

RAILROAD-HIGHWAY CROSSING SIGNAL

Fig. 4

the lane or lanes used by highway traffic approaching the crossing. The gate shall have reflectorized diagonal stripes alternately red and white and red lights as illustrated in Figure 5.

Where public authorities require a bell, it shall be used in conjunction with the flashing light signals.

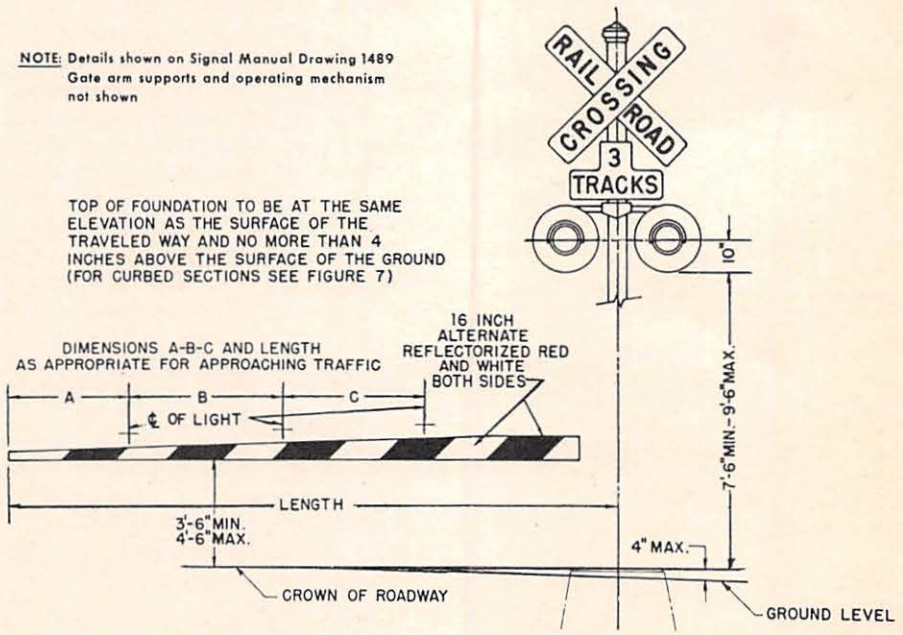
The accelerated construction of multiple-lane highways, along with the need for improving roadside safety by locating rigid supports a greater distance from the edge of the traveled way has generated a greater need for cantilever-mounted signals. A typical cantilever signal is illustrated in Figure 6. Some cantilever designs permit the span to be rotated to the side of the road for servicing. Where provided as a part of the assembly, service ladders should be secured in a way to prevent their use by unauthorized persons.

Design of signal and devices

1. Railroad-Highway Crossing Signal shall conform to Figures 4, 5, or 6 with variations in design and mounting dimensions permissible.
2. The light units on the signal shall be in accordance with Signal Manual Part 166, insofar as it applies, and shall be arranged to provide indications for approaching traffic as required.
3. Bell, when used, shall be in accordance with Signal Manual Part 21.
4. Gate operating mechanism shall be in accordance with Signal Manual Part 194.
5. Light units on gate arm shall be in accordance with Signal Manual Part 263.
6. Painting, when required, shall be in accordance with Signal Manual Part 110 and all metal parts shall be given a finishing coat of white or aluminum, except pinnacles, bells and parts which function as hood or background for signals shall be painted black.
7. Sign indicating number of tracks shall be used where there is more than one track. The number displayed on the sign shall be the total number of tracks between the signals at the crossing.

Application

1. The railroad-highway crossing signal may be used with or without gates and such determination should be made after a study at the site by qualified engineers. Federal and


NOTE: Details shown on Signal Manual Drawing 1489
Gate arm supports and operating mechanism not shown
TOP OF FOUNDATION TO BE AT THE SAME ELEVATION AS THE SURFACE OF THE TRAVELED WAY AND NO MORE THAN 4 INCHES ABOVE THE SURFACE OF THE GROUND (FOR CURBED SECTIONS SEE FIGURE 7)
RAIL
CROSSING
ROAD
3
TRACKS
10"
DIMENSIONS A-B-C AND LENGTH AS APPROPRIATE FOR APPROACHING TRAFFIC
16 INCH ALTERNATE REFLECTORIZED RED AND WHITE BOTH SIDES
A
B
C
℄ OF LIGHT
LENGTH
3'-6"MIN.
4'-6"MAX.
4"MAX.
7'-6"MIN – 9'-6"MAX.
CROWN OF ROADWAY
GROUND LEVEL

RAILROAD-HIGHWAY CROSSING SIGNAL WITH GATE

Fig. 5

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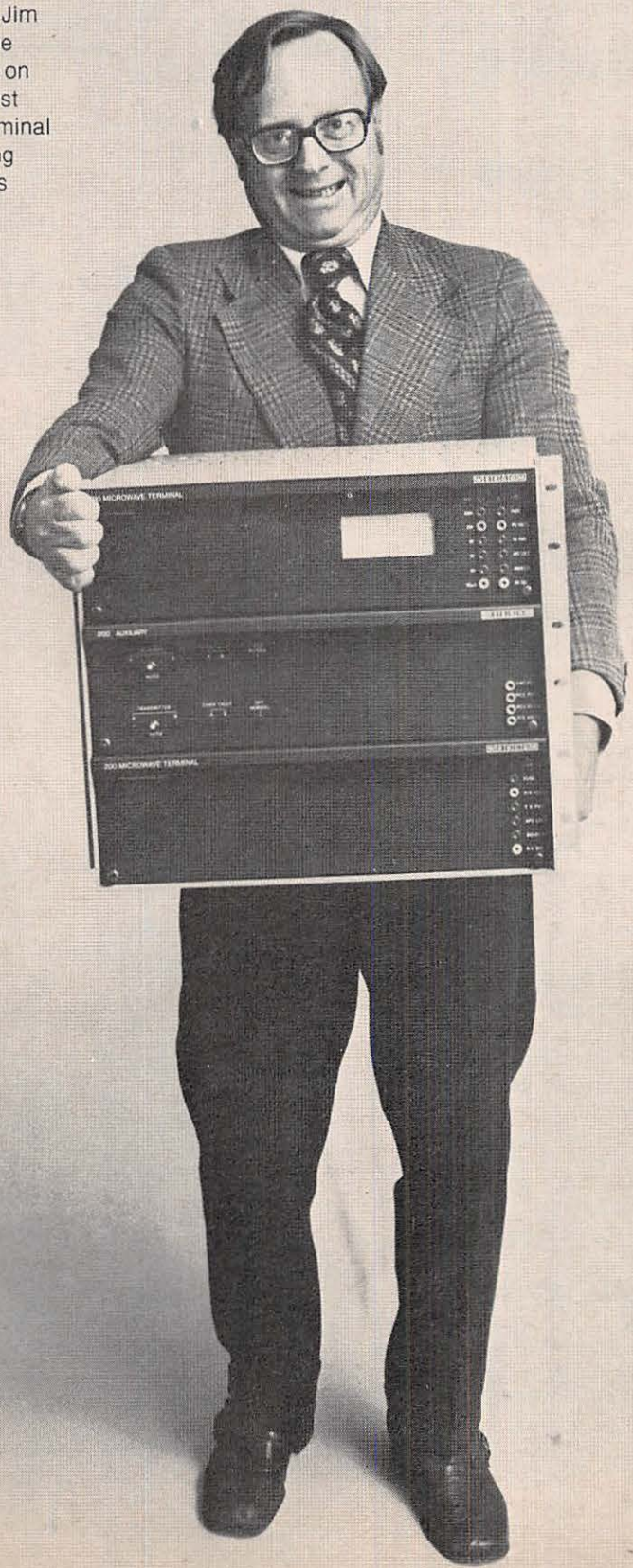
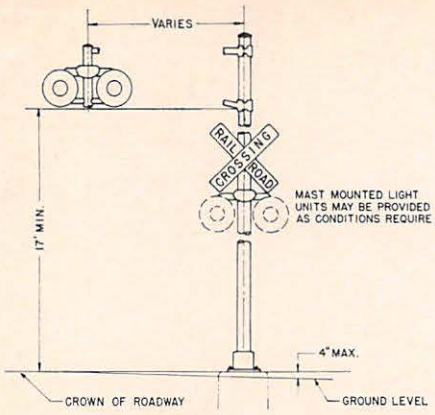
Our point. Size. This 2GHz Terminal with hot standby and orderwire weighs under 100 lbs. and takes only 15¾ inches of rack space.

The man shown here, with only moderately white knuckles, is Jim Lang, Manager of our Microwave operation. Jim had reason to appreciate the size of the 200 Terminal last winter. He balanced on the pontoon of a light plane off the coast of Alaska, and handed a protected terminal to an RCA Alascom technician standing in a motorboat. That terminal now links the FAA at Biorka Island with Sitka.

While your real life situation might not be so precarious, compact size, roll-out equipment drawers, and modular internal packaging allow our 2GHz Terminal to be installed nearly anywhere, and maintained by nearly anyone.



WESCOM


VARIES
RAIL ROAD CROSSING
MAST MOUNTED LIGHT UNITS MAY BE PROVIDED AS CONDITIONS REQUIRE
17' MIN.
4" MAX.
CROWN OF ROADWAY
GROUND LEVEL
TOP OF FOUNDATION TO BE AT THE SAME ELEVATION AS THE SURFACE OF THE TRAVELED WAY AND NO MORE THAN 4 INCHES ABOVE THE SURFACE OF THE GROUND (FOR CURBED SECTIONS SEE FIGURE 7)

NOTE: For details see Signal Manual Drawing 1746

RAILROAD-HIGHWAY CROSSING SIGNAL TYPICAL CANTILEVER SPAN

Fig. 6

state directives may specify types of warning to be installed. The use of gates is a special aid to motorists at crossings where multiple train movements may occur simultaneously. Also, there is an increasing use of gates at single track crossings, particularly in congested urban areas.

2. For two direction traffic, a crossing signal with back-to-back lights shall be placed on each side of the track or group of tracks for which signal warning is to be provided. On one way streets and divided highways the signal may be placed only on the approach side of the crossing.
3. The gate, when used, may be mounted on the highway crossing signal assembly or mounted independently between the signal and the track.
4. For a highway adjacent to and approximately paralleling a railroad, which intersects or joins another highway that crosses the railroad at grade, additional light units may be used to supplement the normal complement of lights.
5. A bell, when used, should be positioned so that the gong is parallel to the highway.
6. In some areas, on other than mainlines, where train speeds are slow, traffic control type signals along with crossbucks may be used at or near the crossing to provide warning and to permit maximum use of streets paralleling the track during time the crossing is blocked by the train.

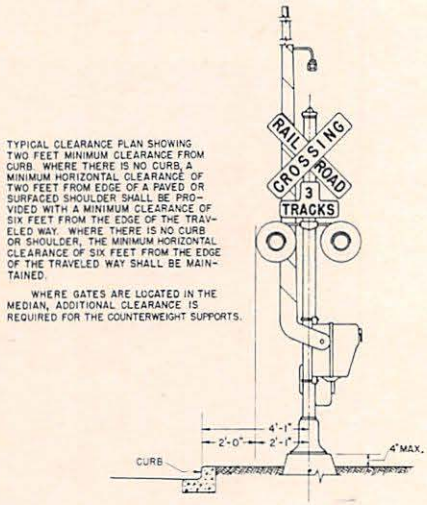
Obedience to signal indicating approach of train

The recommended practices in this bulletin are based on the premise that the operator of a vehicle will act in accordance with applicable rules of the road as they apply at railroad-highway grade crossings

In the UVC, Rules of the Road, Section 11-701, Obedience to signal indicating approach of train reads as follows:

"(a) Whenever any person driving a vehicle approaches a railroad grade crossing under any of the circumstances stated in this section, the driver of such vehicle shall stop within 50 feet but not less than 15 feet from the nearest rail of such railroad and shall not proceed until he can do so safely. The foregoing requirements shall apply when:

1. A clearly visible electric or mechanical signal device gives warning of the immediate approach of a railroad train;
2. A crossing gate is lowered or when a human flagman gives or continues to give a signal of the approach or passage of a train;
3. A railroad train approaching within approximately 1,500 feet of a railroad crossing emits a signal audible from such distance and such railroad train, by reason of its speed or nearness to such crossing, is an immediate hazard;


TYPICAL CLEARANCE PLAN SHOWING TWO FEET MINIMUM CLEARANCE FROM CURB. WHERE THERE IS NO CURB, A MINIMUM HORIZONTAL CLEARANCE OF TWO FEET FROM EDGE OF A PAVED OR SURFACED SHOULDER SHALL BE PROVIDED WITH A MINIMUM CLEARANCE OF SIX FEET FROM THE EDGE OF THE TRAVELED WAY. WHERE THERE IS NO CURB OR SHOULDER, THE MINIMUM HORIZONTAL CLEARANCE OF SIX FEET FROM THE EDGE OF THE TRAVELED WAY SHALL BE MAINTAINED.
WHERE GATES ARE LOCATED IN THE MEDIAN, ADDITIONAL CLEARANCE IS REQUIRED FOR THE COUNTERWEIGHT SUPPORTS.
RAIL ROAD CROSSING
3 TRACKS
4'-1"
2'-0"
2'-1"
4" MAX.
CURB

TYPICAL CURB AND GUTTER PLAN FOR RAILROAD-HIGHWAY CROSSING SIGNALS WITH OR WITHOUT GATES

Fig. 7

4. An approaching railroad train is plainly visible and is in hazardous proximity to such crossing.

(b) No person shall drive any vehicle through, around or under any crossing gate or barrier at a railroad crossing while such gate or barrier is closed or is being opened or closed."

Effective application of grade crossing warning devices depends on minimum display of unauthorized signs, signals or markings. The UVC recognizes this fact in Section 11-205 which reads:

"Display of unauthorized signs, signals and markings.

(a) No person shall place, maintain or display upon or in view of any highway any unauthorized sign, signal, marking or device which purports to be or is an imitation of or resembles an official traffic-control device or railroad sign or signal or which attempts to direct the movement of traffic, or which hides from view or interferes with the effectiveness of an official traffic control device or any railroad sign or signal.

(b) °°°°°°

(c) °°°°°°

(d) Every such prohibited sign, signal or marking is hereby declared to be a public nuisance and the authority having jurisdiction over the highway is hereby empowered to remove the same or cause it to be removed without notice.

Location

The principal aspect of a railroad-highway grade crossing signal, with or without gate, should generally be placed to the right of the approaching highway traffic. Where local conditions require, signals may be placed to the left of approaching traffic and gate arms may be positioned parallel to the tracks instead of at right angles to the highway. Additional light units may be used as needed.

Lateral location of the signal should be selected after study at the site and should be in accordance with Figure 7, which represents a reasonable interpretation of MUTCD Section 4B-14—Transverse Location of Traffic Signal Supports and Controller Cabinets, which reads as follows:

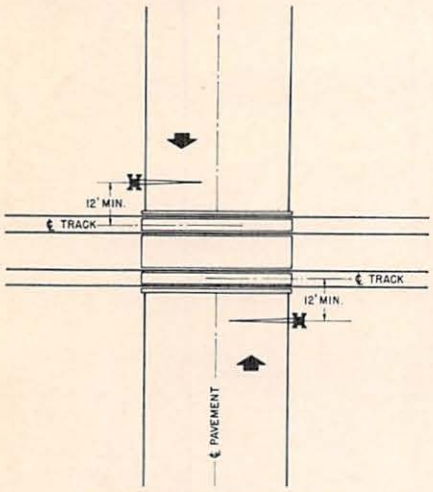
"In the placement of signal supports, primary consideration shall be given to ensuring the proper visibility of signal faces as described in Sections 4B-12 and 13. However, in the interest of safety, signal supports and controller cabinets should be placed as far as practicable from the edge of the traveled way without adversely affecting signal visibility.

Supports for post-mounted signal heads at the side of a street with curbs shall have a horizontal clearance of not less than two feet from the face of a vertical curb. Where there is no curb, supports for post-mounted signal heads shall have a horizontal clearance of not less than two feet from the edge of a shoulder, within the limits of normal vertical clearance. A signal support should not obstruct a crosswalk.

No part of a concrete base for a signal support should extend more than 4 inches above the ground level at any point, except that this limitation does not apply to the concrete base for a rigid (non-breakaway) support.

On medians, the above minimum clearances for signal supports should be obtained where practicable. Any supports which cannot be located with the

required clearances should be of the breakaway type or should be guarded if at all practicable."



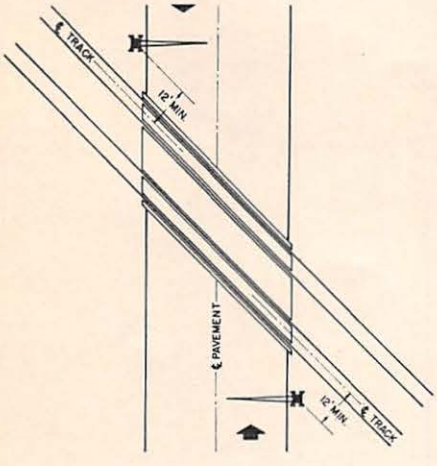
Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

TYPICAL LOCATION PLAN FOR RAILROAD-HIGHWAY CROSSING SIGNALS WITH OR WITHOUT GATES FOR TWO-WAY HIGHWAY TRAFFIC

RIGHT ANGLE

Fig. 8

In any event, a minimum horizontal clearance of two feet should be provided from the face of the curb. Where there is no curb a minimum horizontal clearance of two feet from the edge of a paved or surfaced shoulder shall be provided with a minimum clearance of six feet from the edge of the traveled way. Where there is no curb or paved shoulder, the minimum horizontal clearance of six feet shall be maintained. All horizontal clearances shall extend for a vertical distance of 17 feet above the roadway surface, for all parts of the signal and associated items and for the gate arm in its normal upright position.



Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

TYPICAL LOCATION PLAN FOR RAILROAD-HIGHWAY CROSSING SIGNALS WITH OR WITHOUT GATES FOR TWO-WAY HIGHWAY TRAFFIC

ACUTE ANGLE

Fig. 9

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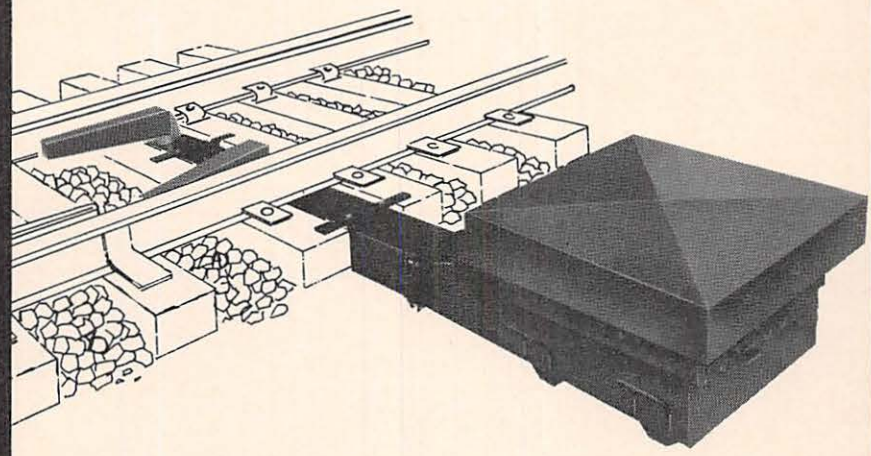

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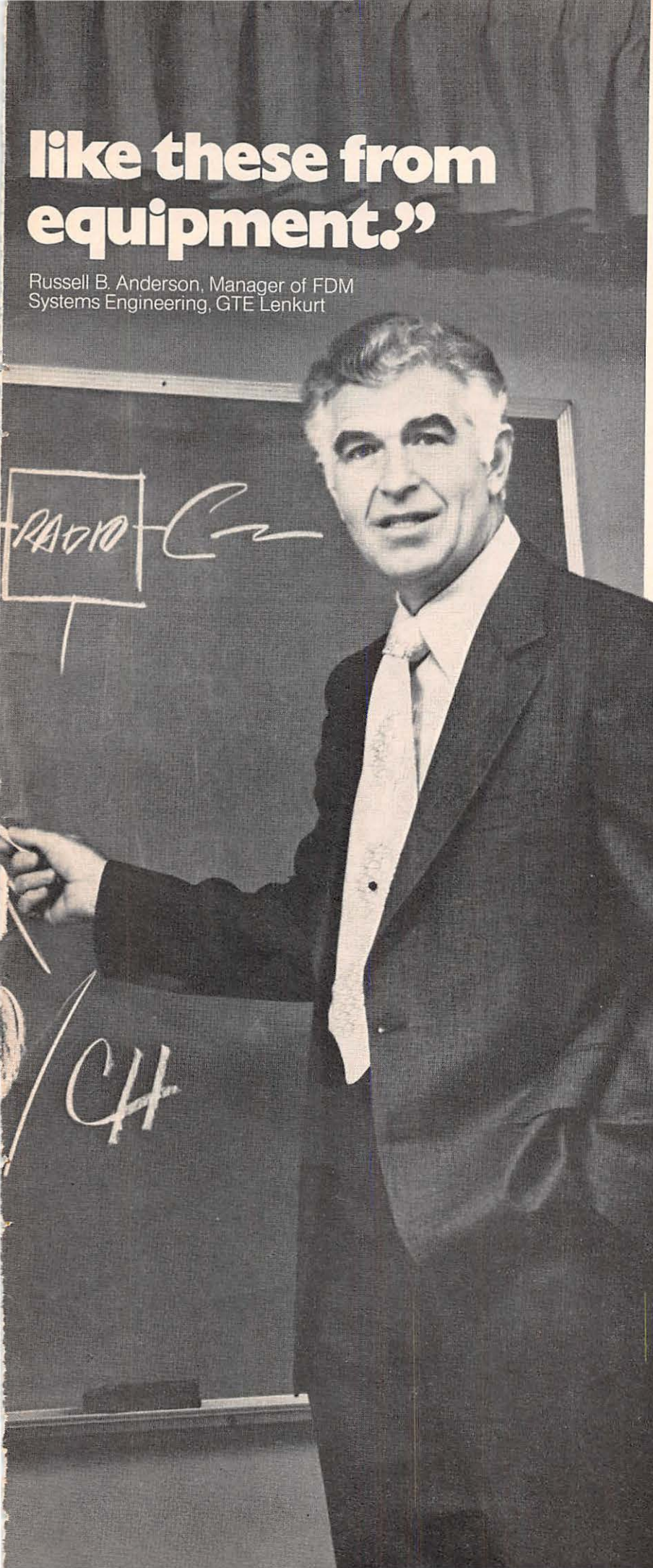
Russell B. Anderson, Manager of FDM Systems Engineering, GTE Lenkurt



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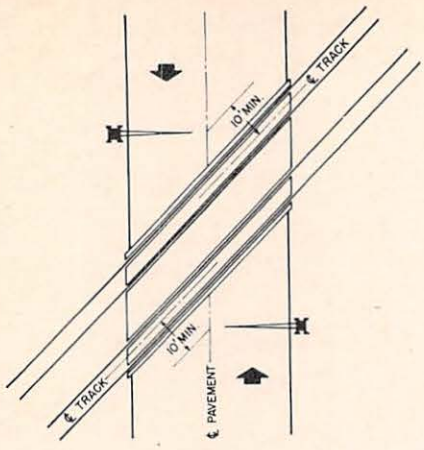


Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

TYPICAL LOCATION PLAN FOR RAILROAD-HIGHWAY CROSSING SIGNALS WITH OR WITHOUT GATES FOR TWO-WAY HIGHWAY TRAFFIC

OBTUSE ANGLE

Fig. 10

Where local conditions will permit, a lateral escape route to the right of the highway in advance of the crossing warning signal should be kept free of guard rail or other above ground obstructions. Placement of the guard rails is the responsibility of the highway authorities. Where guard rail is not deemed necessary nor appropriate by highway authorities, rigid non-yielding type barriers are not to be used for protecting signal supports. In industrial and other areas involving only low-speed highway traffic and where signals are susceptible to being struck by turning truck traffic such as in terminal areas, alleys, warehouse areas, etc., ring type guardrail may be installed to provide protection for the signal assembly.

Figures 8-19 show typical location plans for railroad-highway grade crossing signals and gates.

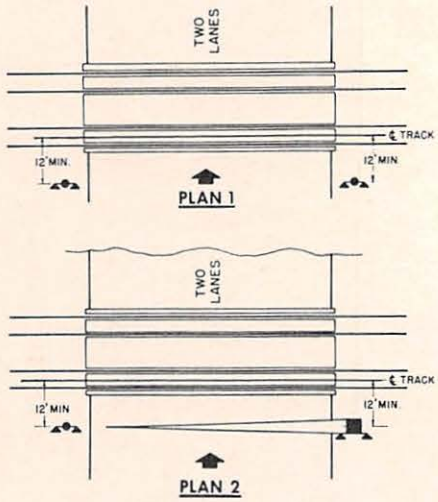
Operating requirements

1. Flashing light units shall flash alternately. The number of flashes per minute for each incandescent lamp shall be 35 minimum and 55 maximum.
2. Each lamp shall be illuminated approximately the same length of time. Total time of illumination of each pair of lamps shall be practically the entire operating time.
3. Gate arm, when in raised position, shall not obstruct or interfere with pedestrian or highway traffic.

Controls for operation

General

1. Signals and devices which indicate the approach of a train shall be so controlled that they will operate for such period of time before arrival of any train operated over the crossing as is reasonably required to afford warning.
2. Controls, including electric, electronic and mechanical methods, shall be in accordance with Signal Manual Part 34, insofar as it applies, and as far as practicable shall be so designed that in the event of failure of any part, the operation required of the signals and devices will be provided.
3. Where means are provided to suspend operation of the warning devices during intervals when trains make regular operating stops or perform switching operations on approach circuits:
   (a) Controls shall be so designed as to resume operation of warning devices before a train reaches a crossing.
   (b) Automatic control of warning devices actuated by approaching trains, other than the train that has stopped or is performing switching operations, shall take precedence over any feature provided to suspend operation.



Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

TYPICAL LOCATION PLANS FOR RAILROAD-HIGHWAY CROSSING SIGNALS WITH OR WITHOUT GATES FOR ONE-WAY HIGHWAY TRAFFIC (TWO LANES)

RIGHT ANGLE

Fig. 11

4. Where manual supervisory control of warning devices is provided in addition to automatic control:
   (a) Automatic control actuated by approaching trains other than that for which manual control has been made effective shall take precedence over the manual control.
   (b) Means shall be provided to restore the controls to automatic operation.
   (c) Means shall be provided to prevent manual operation by unauthorized persons.

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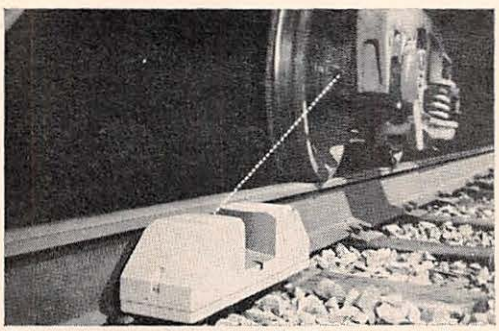
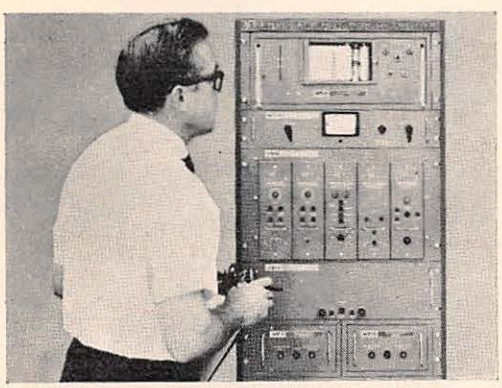
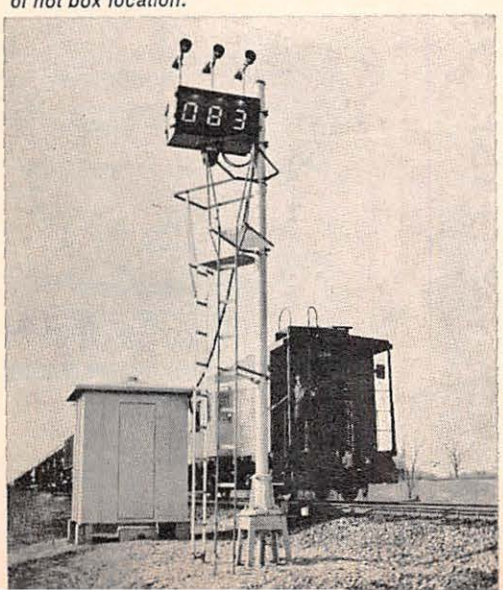


Rail-mounted scanner "looks" at and measures the heat radiated by passing journal boxes.



Solid state electronic data processing equipment, with permanent record chart recorder.

Trackside display board gives digital read-out of hot box location.



BECAUSE SERVOSAFE CAN REDUCE MAINTENANCE COSTS. Journal box and wheel set maintenance represent substantial costs each year. Part of these costs is due to normal bearing wear as cars age. Much higher costs, however, are involved when equipment is needlessly damaged by continued operation after lubrication has failed—causing major salvage jobs or replacement of wheel sets.

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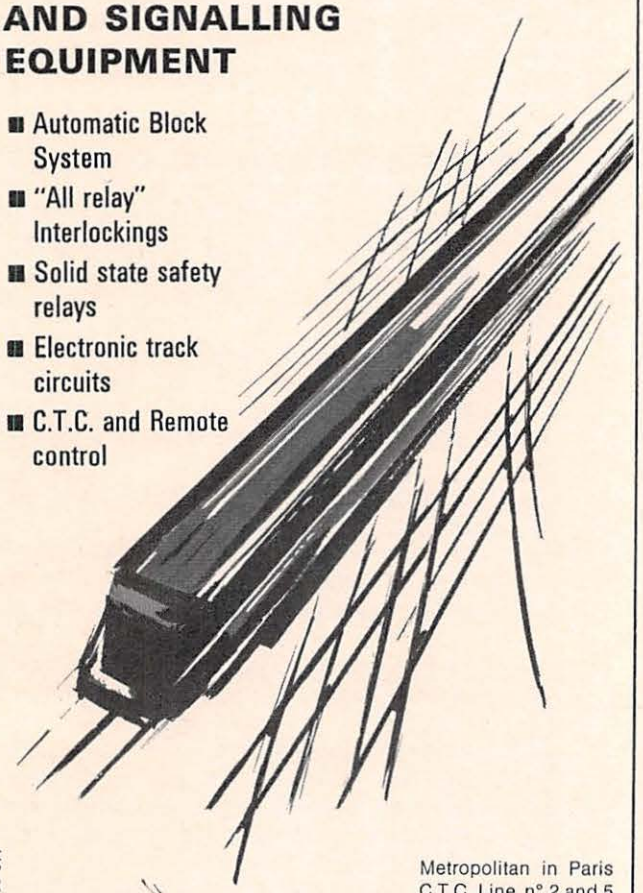

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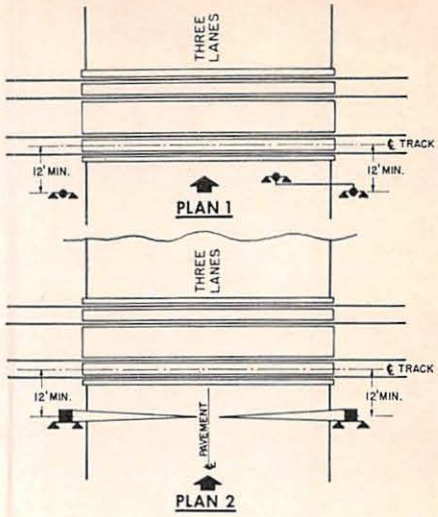


Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

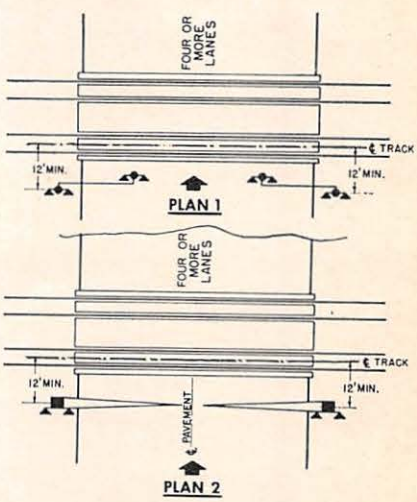
TYPICAL LOCATION PLANS
FOR RAILROAD HIGHWAY CROSSING SIGNALS
WITH OR WITHOUT GATES
FOR ONE-WAY HIGHWAY TRAFFIC (THREE LANES)

RIGHT ANGLE

Fig. 12

Specific requirements for automatic signals

1. On tracks where trains operate at a speed of 20 miles per hour or higher, the signals shall operate for not less than 20 seconds before arrival of any train on such track. On other tracks used for switching and assembling trains such as industrial leads, sidings, switching tracks and storage tracks, means shall be provided to warn approaching highway traffic.
2. Signals shall operate whenever any part of the train occupies the crossing.
3. Where train speeds on a given track vary considerably under normal operation and volume of railroad and

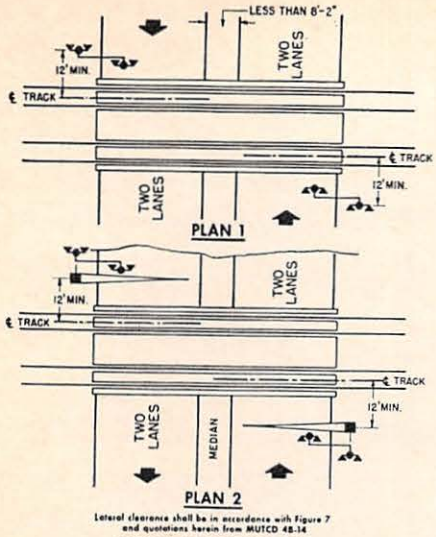


Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

TYPICAL LOCATION PLANS
FOR RAILROAD-HIGHWAY CROSSING SIGNALS
WITH OR WITHOUT GATES
FOR ONE-WAY HIGHWAY TRAFFIC (FOUR OR MORE LANES)

RIGHT ANGLE

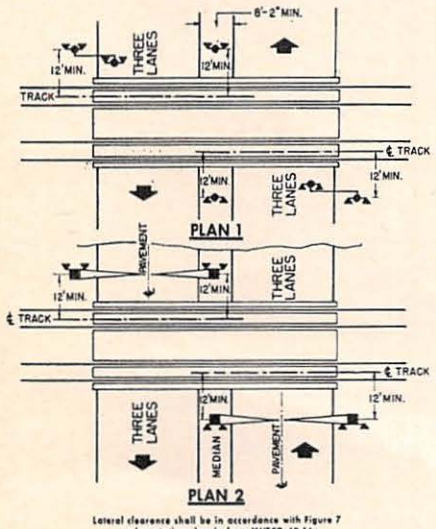
Fig. 13



Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

TYPICAL LOCATION PLANS
FOR RAILROAD-HIGHWAY CROSSING SIGNALS
WITH OR WITHOUT GATES
FOR ONE-WAY HIGHWAY TRAFFIC (TWO LANES)
DIVIDED HIGHWAY
RIGHT ANGLE

Fig. 14



Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14.

TYPICAL LOCATION PLANS
FOR RAILROAD-HIGHWAY CROSSING SIGNALS
WITH OR WITHOUT GATES FOR
FOR ONE-WAY HIGHWAY TRAFFIC (THREE LANES)
DIVIDED HIGHWAY
RIGHT ANGLE

Fig. 15

highway traffic warrants, special devices or circuits should be installed to provide reasonably consistent warning time for all movements. Under similar traffic volume conditions special control features should be used to eliminate the effects of station stops and switching operations within approach control circuits.

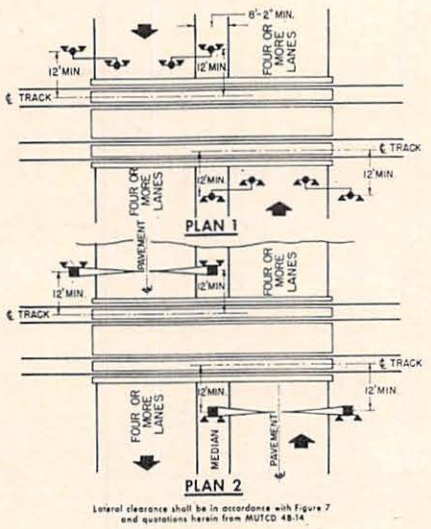
4. A bell, when used, should sound a warning during the time the signal lights are operating, except it may be silenced when head end of the train reaches the crossing, or when the gate has descended to within 10 degrees of horizontal.

Specific requirements for automatic gates

1. Gate arm lights shall operate in combination with the highway grade crossing signal at all times when gate is in position to obstruct traffic. The light nearest the tip of the gate shall burn steadily and two lights shall flash alternately in unison with the signal lights.
2. The gate arm shall start its downward motion not less than 3 seconds after the signal lights start to operate.
3. The gate arm shall reach the horizontal position before arrival of any train and shall remain in that position as long as the train occupies the crossing.

Installation

Installation of railroad-highway grade crossing signals and devices shall be in accordance with Signal Manual Part 149. In some states the authority having jurisdiction approves the plans for installation and if Federal funds are involved, approval of the Federal Highway Administration is likewise required.



Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

TYPICAL LOCATION PLANS
FOR RAILROAD-HIGHWAY CROSSING SIGNALS
WITH OR WITHOUT GATES
FOR ONE-WAY HIGHWAY TRAFFIC (FOUR OR MORE LANES)
DIVIDED HIGHWAY
RIGHT ANGLE

Fig. 16

Traffic control signals near grade crossings

The MUTCD contains recommendations for effective coordination of railroad-highway grade crossing signals with traffic control signals. 4B-21 of the MUTCD reads as follows:

"When a railroad grade crossing, protected by train-approach signals (secs. 4F-1 and 2), is within or near an

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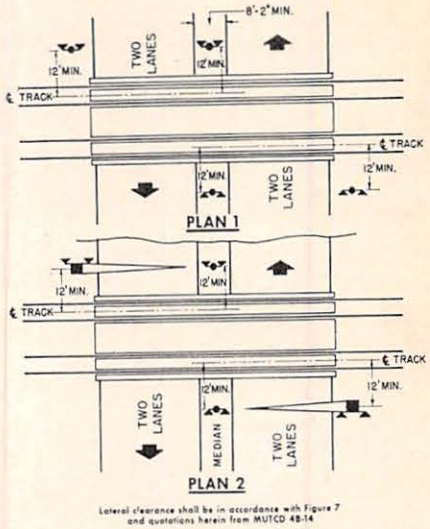
intersection controlled by a traffic signal, the control of the traffic signal should be preempted from the signal controller upon the approach of trains to avoid conflicting aspects of the traffic signal and the train-approach signal. This preemption feature requires a closed electrical circuit between the control relay of the train-approach signals and the preemptor in order to establish and maintain the preempted condition during the time that the train-approach signals are in operation. Except under unusual circumstances, the interconnection should be limited to the traffic signals within 200 feet of the crossing.

Traffic control signals shall not be used on mainline railroad crossings in lieu of railroad grade crossing protective devices. However, at industrial track crossings and other places where train movements are very slow (as in switching operations), traffic control signals may be used in lieu of conventional train approach signals to warn motorists of the approach or presence of a train. The provisions of this part relating to traffic signal design, installation and operation are applicable as appropriate where traffic control signals are so used.

At crossings where train movements



Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

TYPICAL LOCATION PLANS
FOR RAILROAD-HIGHWAY CROSSING SIGNALS
WITH OR WITHOUT GATES
FOR ONE-WAY HIGHWAY TRAFFIC (TWO LANES)
DIVIDED HIGHWAY
RIGHT ANGLE

Fig. 17

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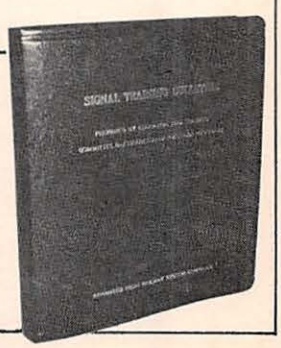
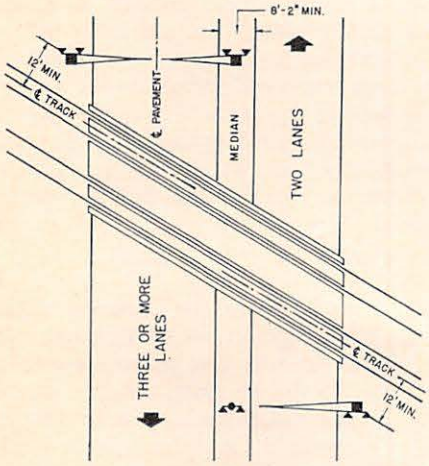


are regulated or limited to the extent that train-approach signals are not required, preemption of the adjacent signalized intersections may be desirable to permit non-conflicting highway traffic to proceed during the time the crossing is blocked by a train. Except under unusual circumstances, the interconnection should be limited to the traffic signals within 200 feet of the crossing.

The preemption sequence initiated when the train first enters the approach circuit, shall at once bring into effect a signal display which will permit all vehicles to clear the tracks before the train reaches the intersection or any approach thereto.

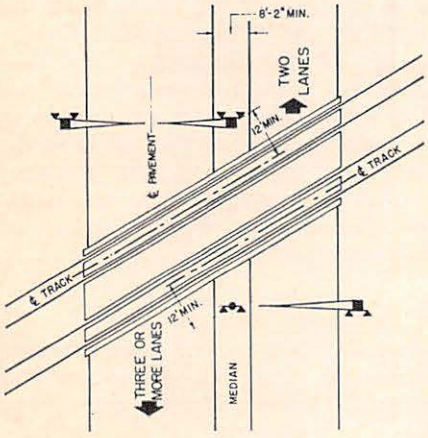


Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

NOTE: For flashing light signals only see Figures 11, 12, 14, 15, and 17.

TYPICAL LOCATION PLAN (COMPOSITE) FOR RAILROAD-HIGHWAY CROSSING SIGNALS AND GATES FOR ONE-WAY HIGHWAY TRAFFIC DIVIDED HIGHWAY ACUTE ANGLE

Fig. 18



Lateral clearance shall be in accordance with Figure 7 and quotations herein from MUTCD 4B-14

NOTE: For flashing light signals only see Figures 12, 13, 15, and 16.

TYPICAL LOCATION PLAN (COMPOSITE) FOR RAILROAD-HIGHWAY CROSSING SIGNALS AND GATES FOR ONE-WAY HIGHWAY TRAFFIC DIVIDED HIGHWAY OBTUSE ANGLE

Fig. 19

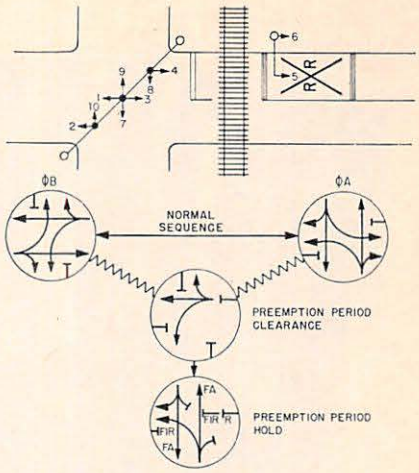
When the green indication is preempted by train operation, a yellow change interval must be inserted in the signal sequence in the interest of safety and consistency. To avoid misinterpretation during the time that the clear-out signals are green, consideration should be given to the use of 12-inch red lenses in the signals which govern movements over the tracks (sec 4B-8).

After the track clearance phase, the traffic control signal may be operated to permit vehicle movements that do not cross the tracks, but in all cases shall prohibit movement over the tracks.

Where feasible the location and the normal (no trains involved) phasing and timing of traffic control signals near railroad grade crossings should be designed so that vehicles are not required to stop on the tracks even though in some cases this will increase the waiting time. The exact nature of the displays and the location of the signals to accomplish this will depend on the physical relationship of the tracks to the intersection area.

When the train clears the crossing it is necessary to return the signal to a designated phase, normally the traffic movement crossing the tracks.

As used herein, the terms "train" and "railroad" shall include transit vehicles operating upon stationary rails or tracks on private right-of-way."



SIGNAL	ΦA		ΦB			PREEMPTION SEQUENCE					
	R/W	CLEAR	R/W	CLEAR$_1$	CLEAR$_2$	Ph$_1$ CLEAR	Ph$_2$ CLEAR		HOLD	CLEAR	RELEASE
1,2	R	R	G	G	A	R	A	R	FIR	R	G
3,4	R	R	G	G	A	R	G	A	FIR	R	G
5,6	R	R	G	A	R	R	A	R	R	R	G
7,8	G	A	R	R	R	A	R	R	FA R	A R	R
9,10	G	A	R	R	R	A	R	R	FA R	A R	R

TYPICAL RAILROAD PREEMPTION SEQUENCE

Fig. 20

Figure 20 illustrates typical traffic signal phasing where preemption is present. It is recommended that the provisions of the MUTCD be followed whenever an interconnection between traffic control signals and railroad-highway grade crossing signals is made.

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50 YEARS AGO IN

Railway Signaling

Vol. 17 DECEMBER, 1924 No. 12

Every expenditure for additions and betterments installed voluntarily by the railroads today, must show a decided saving, either in train operation, or in the cost of maintenance and operation to warrant its authorization. Some roads require that a proposed improvement show a 10 per cent saving on the investment; others demand a 25 per cent saving, while some of the roads which are in a straitened financial condition have difficulty in securing money, for improvements that will show a 100 per cent saving.

When figuring savings on improved methods of signal maintenance or operation, the savings are ordinarily determined quite definitely beforehand. Where an investment of $6,000 for interlocking apparatus will eliminate the necessity for towermen, the savings in wages are at once apparent. However, when it comes to figuring the saving in time and money in the operation of trains by signaling a division, the average man encounters so many factors that the results are too often intangible.

* * *

For the transmission of train orders, the railroads of the United States are using the telegraph on 132,661 miles of road, while the telephone is used for this purpose on 131,-329 miles of road. These totals are given in the annual report as of January 1, 1924, compiled by the Bureau of Safety of the Interstate Commerce Commission from information given by over 560 roads in response to the Commission's order of October 2, 1923.

* * *

Radio election returns were provided for passengers aboard the Twentieth Century Limited on the New York Central, which ran on election night in three sections eastbound and three sections westbound. The receiving sets were placed on the book-case shelves at the forward end of the observation cars at the rear of the trains, each one manned by an engineer from the Western Electric Company. The all-steel cars, the oscillation and swing of the trains around curves and even their passage through tunnels and highest speed, failed to prevent the continuous delivery of election returns. In all respects this fast-train radio service was the most notable success yet attained from prolonged experiments along this line. The company is now considering permanent installation on its fast trains of radio sets adapted to give news and entertainment programs.

* * *

The Imperial Government Railways of Japan have ordered 287 Style-R color-light signals and accessories from the Union Switch & Signal Company, for the extension of automatic block signaling.

* * *

The Great Northern has placed a contract with the General Railway Signal Company covering materials for a complete dc automatic block signal system on approximately 400 track miles of their line. GRS, Type-D color-light signals will be installed between Williston, N.D. and Wolf Point, Mont., and between Havre and Cut Bank, Mont.

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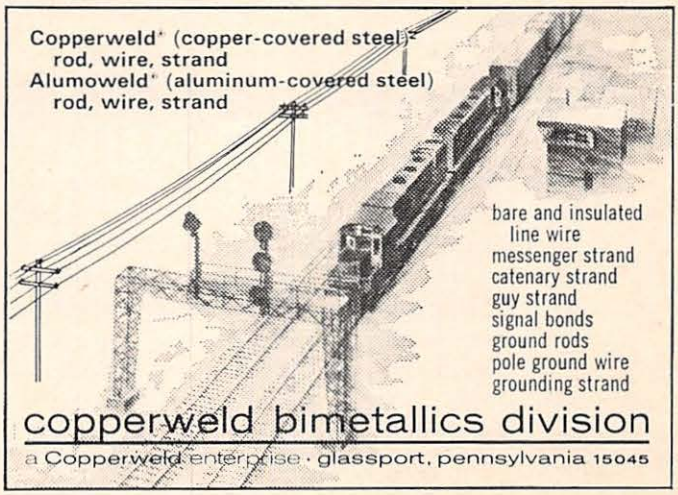

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Editor's Corner

AL KLINGER

Twelve-inch roundel too hot to touch?

At the recent Communication & Signal Section meeting in Atlanta, Ga., the AAR's "Recommended practices for railroad-highway grade crossing warning systems," Bulletin No. 7, came under fire by some of the members attending. As a result, even though hundreds of copies have already been distributed, Bulletin 7 did not receive the full endorsement of the C&S section and therefore was not approved.

What part of Bulletin 7 was found to be unacceptable to some of the members? The hot discussion was due to a short sentence near the end of the bulletin which reads, "To avoid misinterpretation during the time that the clear-out signals are green, consideration should be given to the use of 12-inch red lenses in the signals which govern movements over the tracks."

Those objecting to the mention of the 12-inch roundel felt that it may put railroads in a very bad position when fighting lawsuits resulting from accidents at grade crossings. Some sharp lawyer could say "but my client might have seen the warning lights if your railroad had installed the larger roundel which the AAR claims will avoid misinterpretation."

Others at the convention felt this was a weak argument. After all, a lawyer can also say a great deal about a crossing with *no* form of automatic protection. Or what about those crossings which only have flashing lights, or those with the old style wig-wag? Bulletin 7 points out the advantages of using crossing gates and flashing lights over those crossings with little or no protection. It is just going a step further to say that there may be an advantage in using the 12-inch lens.

Is there an advantage? Well, it is bigger, but the total light output may not be much more than that of an 8⅜-inch roundel. So far, most of the installations using the 12-inch roundel are using the same 18-watt bulb as that used in the 8⅜-inch roundel. One manufacturer says that the light output is greater because the larger reflector used with the 12-inch roundel takes better advantage of the light output from the low wattage bulb. But exactly how much greater is the light output? No one is saying.

So if we have a bigger lens why not go to a higher wattage bulb? While this may be simple for new installations, it could present some power-requirement problems for existing equipment. Even if a higher wattage bulb is used with the 12-inch roundel, does "bigger and brighter" necessarily mean "better"? Logic says yes, but no one has yet conducted any type of research on the matter. Perhaps this is the next step which should be taken. Not necessarily by a manufacturer, but instead by an independent research laboratory—one qualified and equipped to conduct a technical examination of the 12-inch roundel. Perhaps, and maybe even more important, someone should investigate the human response to the 12-inch roundel.

This may all sound very time-consuming and perhaps a bit extreme, but if it will help determine the value of the 12-inch roundel, and give everyone a firmer understanding of how to improve grade crossing safety, then we had better get started right away.

Solar energy may see growing use

Converting the sun's energy to electricity is no longer an impractical dream. With the growing cost of electricity and power transmission, solar energy may be a very serious option when selecting a power source for your signal or communication equipment.

Currently there are two manufacturers promoting solar energy systems for railroad signal and communication applications: Solar Power Corp. of Braintree, Mass., and Spectrolab, which is a division of Textron Inc., located in Sylmar, Calif. Spectrolab equipment is sold under the trademark of "Solar UPS" (Uninterruptible Power Systems).

Each company claims certain advantages in using its system over the other. Although certain packaging and system design characteristics are different, both have proven themselves many times over.

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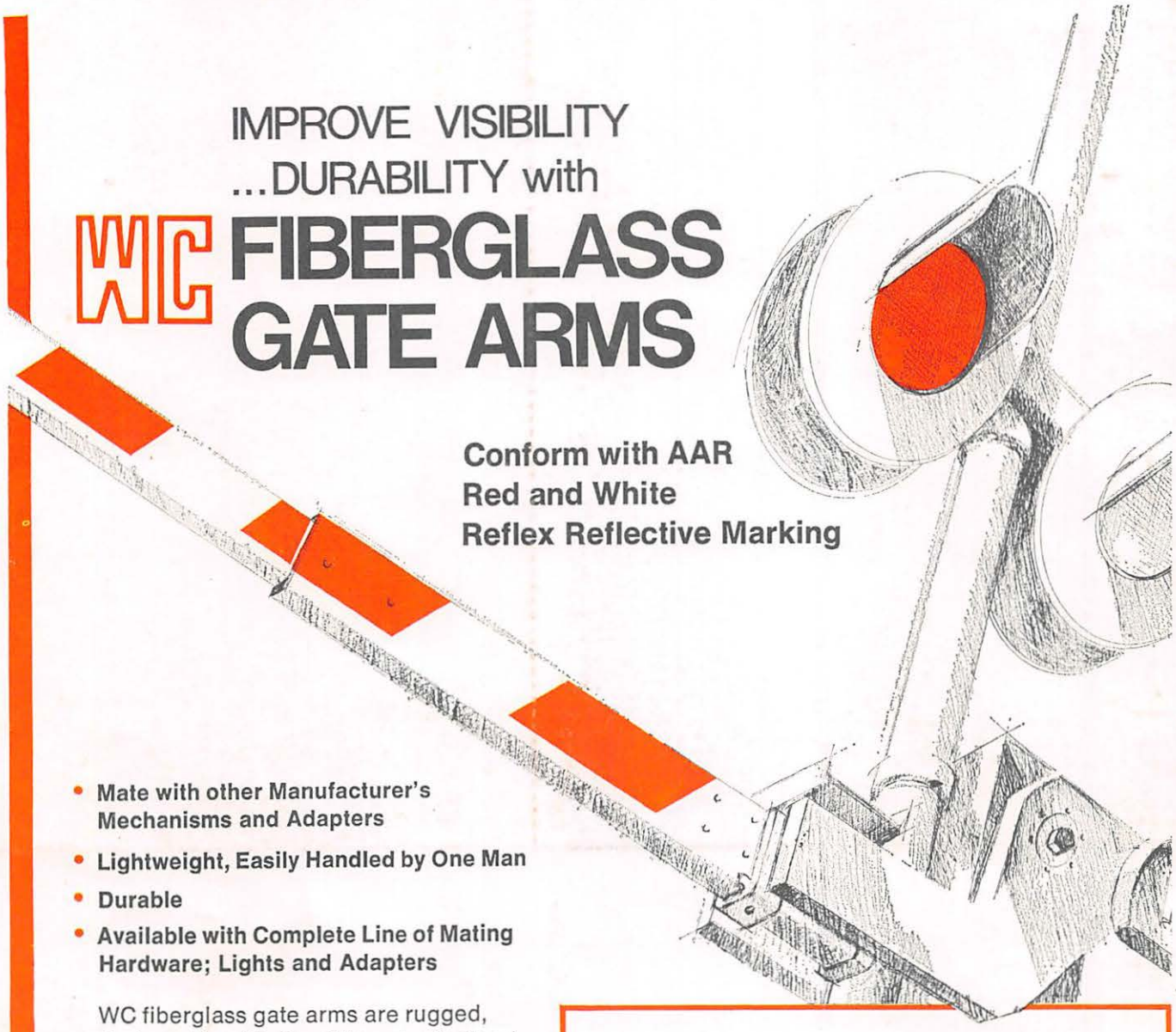

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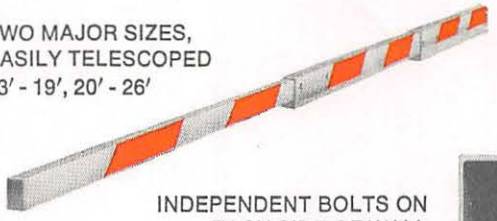

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